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[54] **SOUND ATTENUATING IMPROVEMENTS FOR FOUNDRY MOLDING MACHINES**

[75] Inventors: **Warren A. Blower**, Brecksville; **Harry R. Nara**, Novelty, both of Ohio

[73] Assignee: **The Sherwin-Williams Company**, Cleveland, Ohio

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[21] Appl. No.: **314,377**

[52] **U.S. Cl.** .... **164/206**; 164/197; 91/216 B; 91/325; 92/85; 181/36 R

[51] **Int. Cl.**² **B22C 15/18**; B22C 15/14; F01B 15/00; F01L 21/02

[58] **Field of Search** .... 92/85, 117 R, 217, 250, 92/249; 91/216 B, 216 R, 216 A, 325; 164/206, 203, 39, 261, 196, 197; 181/36 A, 36 R, 71

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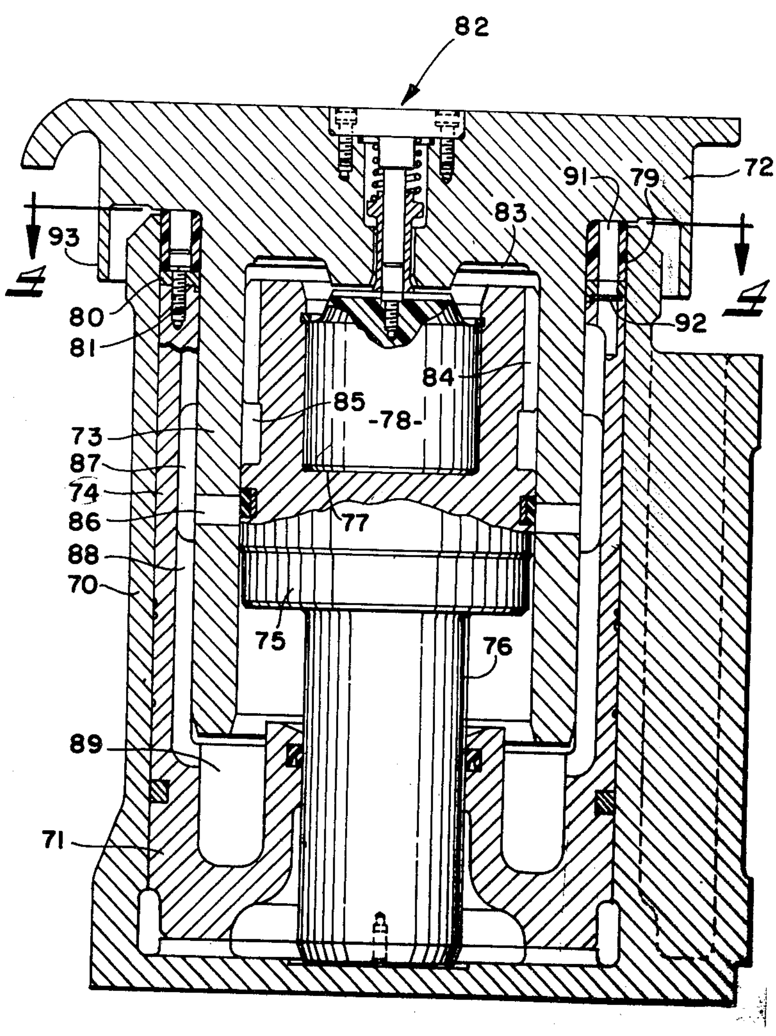
Primary Examiner—Paul E. Maslousky

Attorney, Agent, or Firm—Donnelly, Maky, Renner & Otto

[57] **ABSTRACT**

Jolt foundry molding machines incorporating specially constructed jolt impact receiving surfaces and exhaust and valve systems which achieve the required jolt impact to make satisfactory foundry molds while nevertheless attenuating the noise normally produced by such machines as required by the Occupational Safety & Health Act Standards.

26 Claims, 8 Drawing Figures



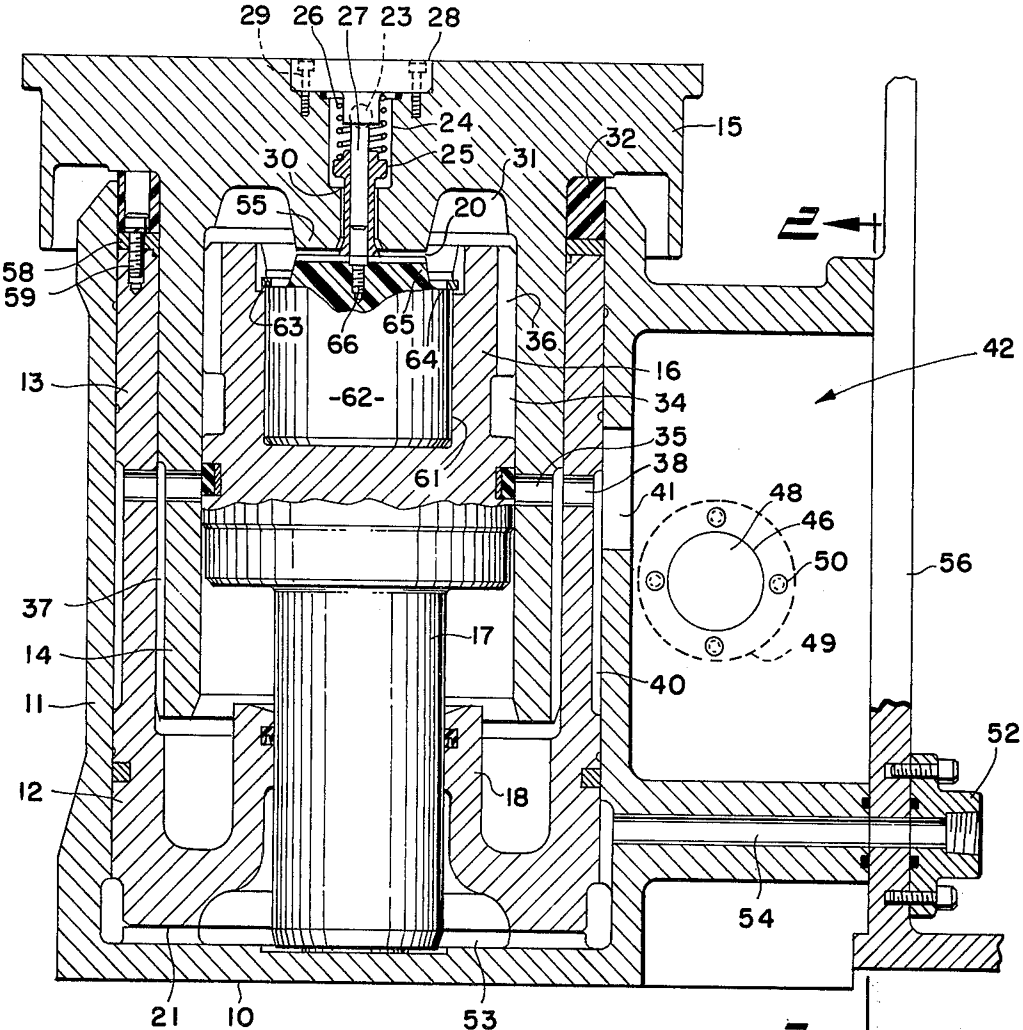

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FIG. 1

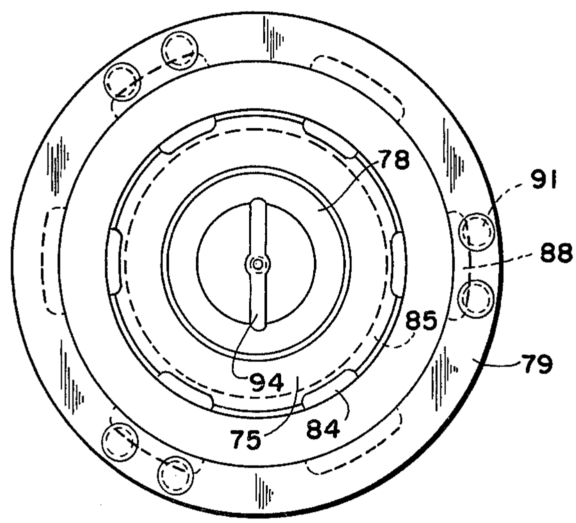
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FIG. 4

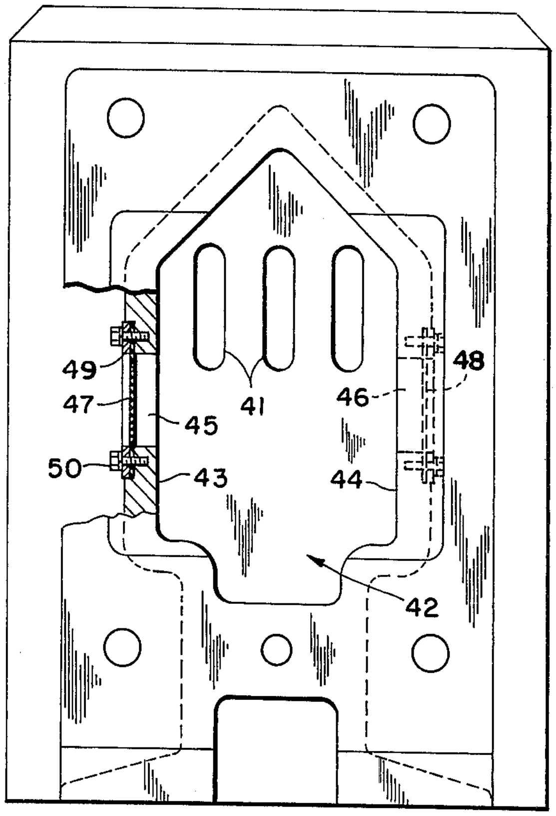
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FIG. 2

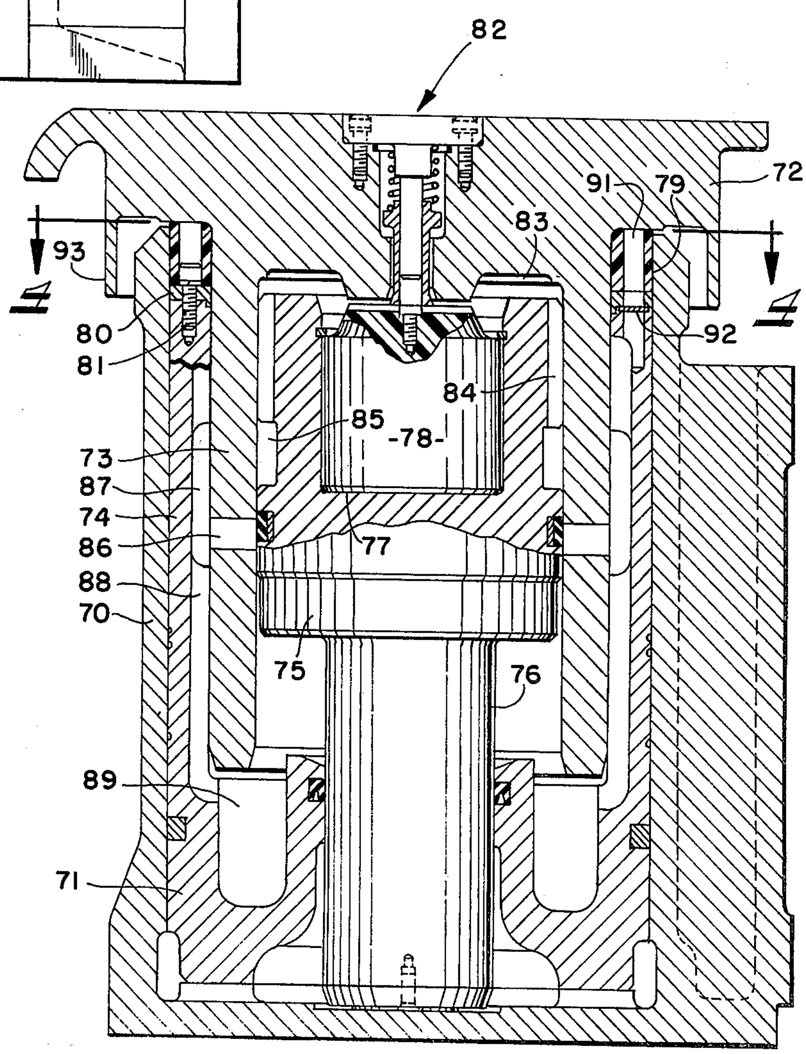
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FIG. 3

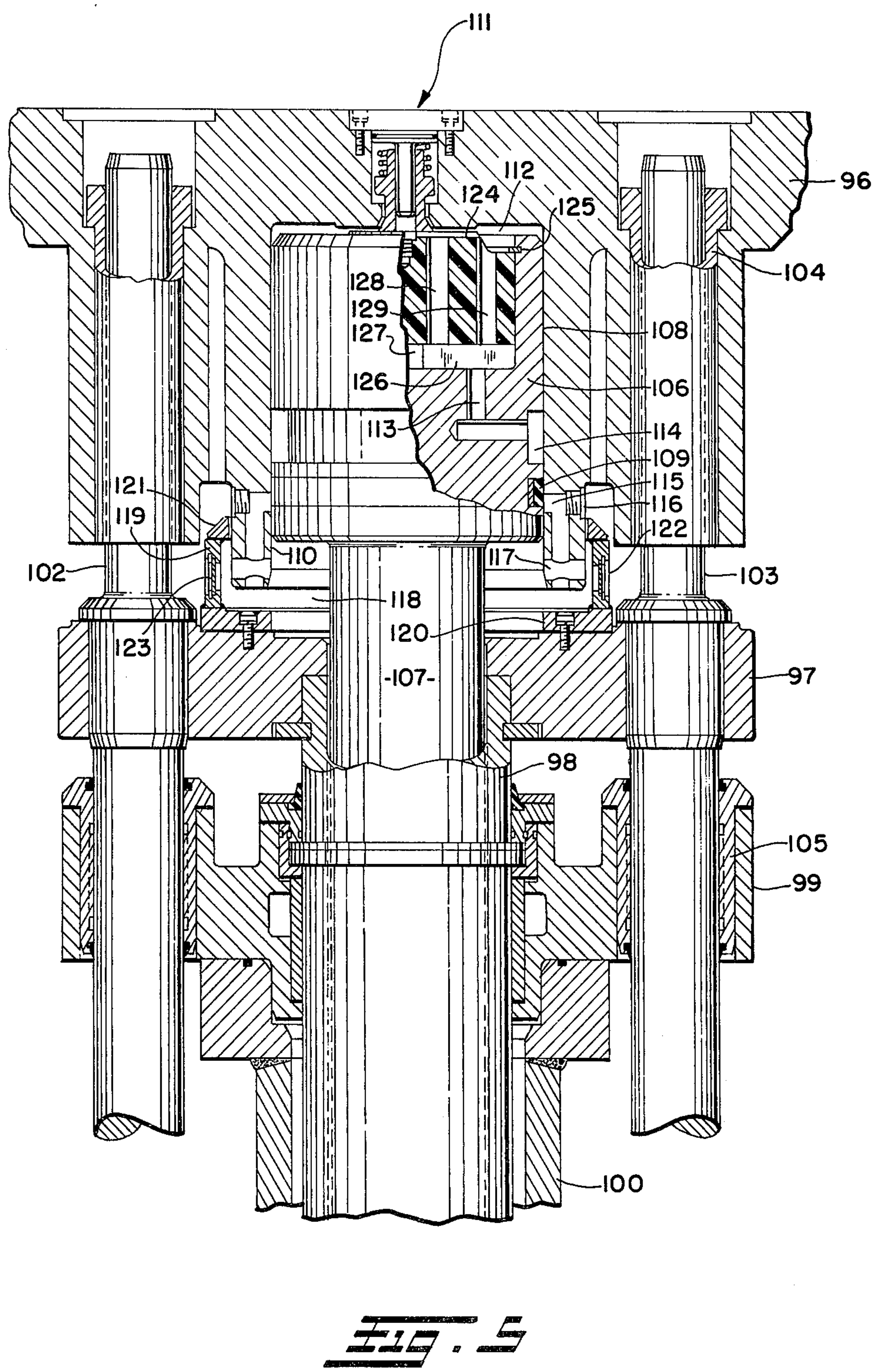
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FIG. 5

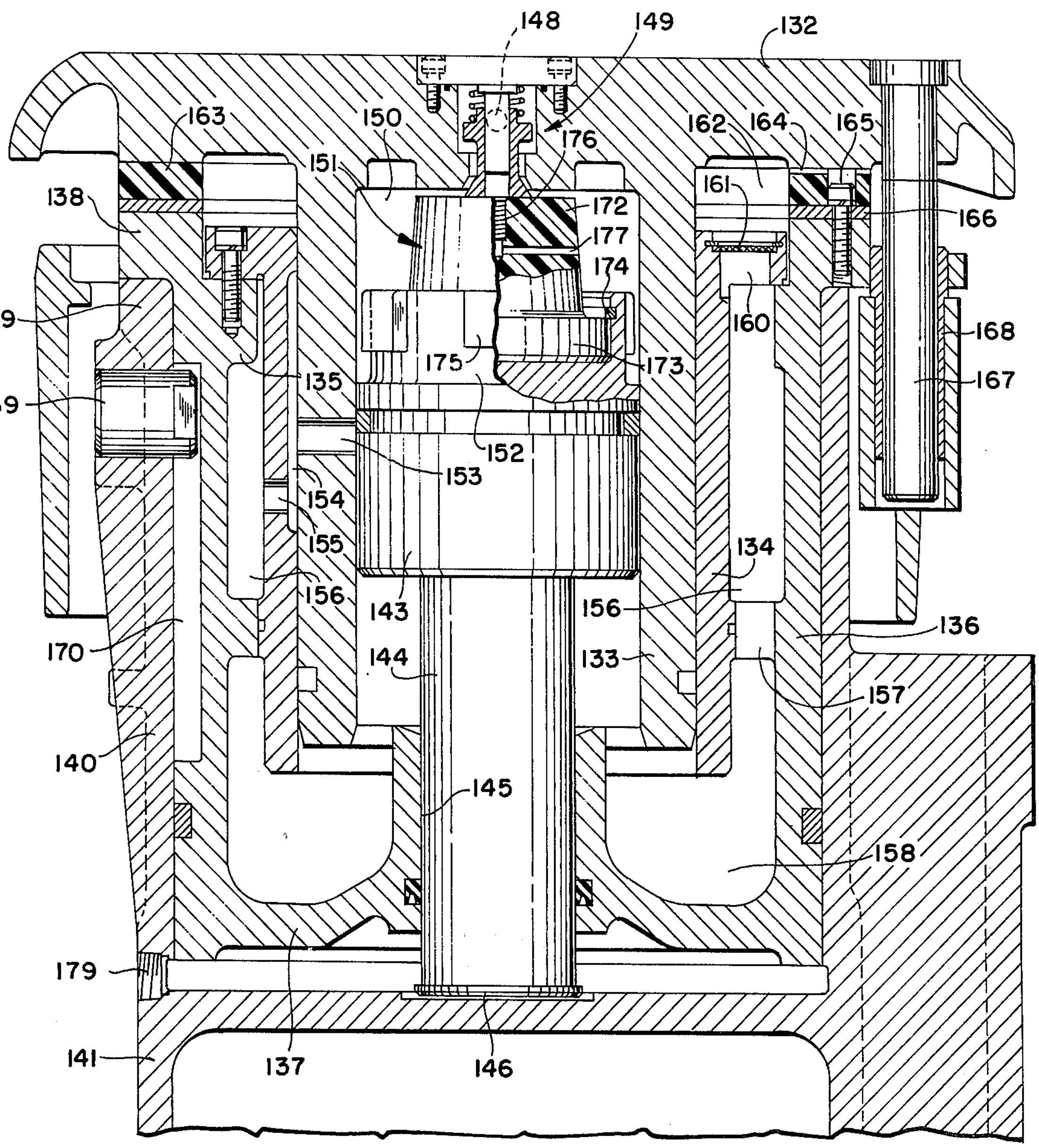
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FIG. 6

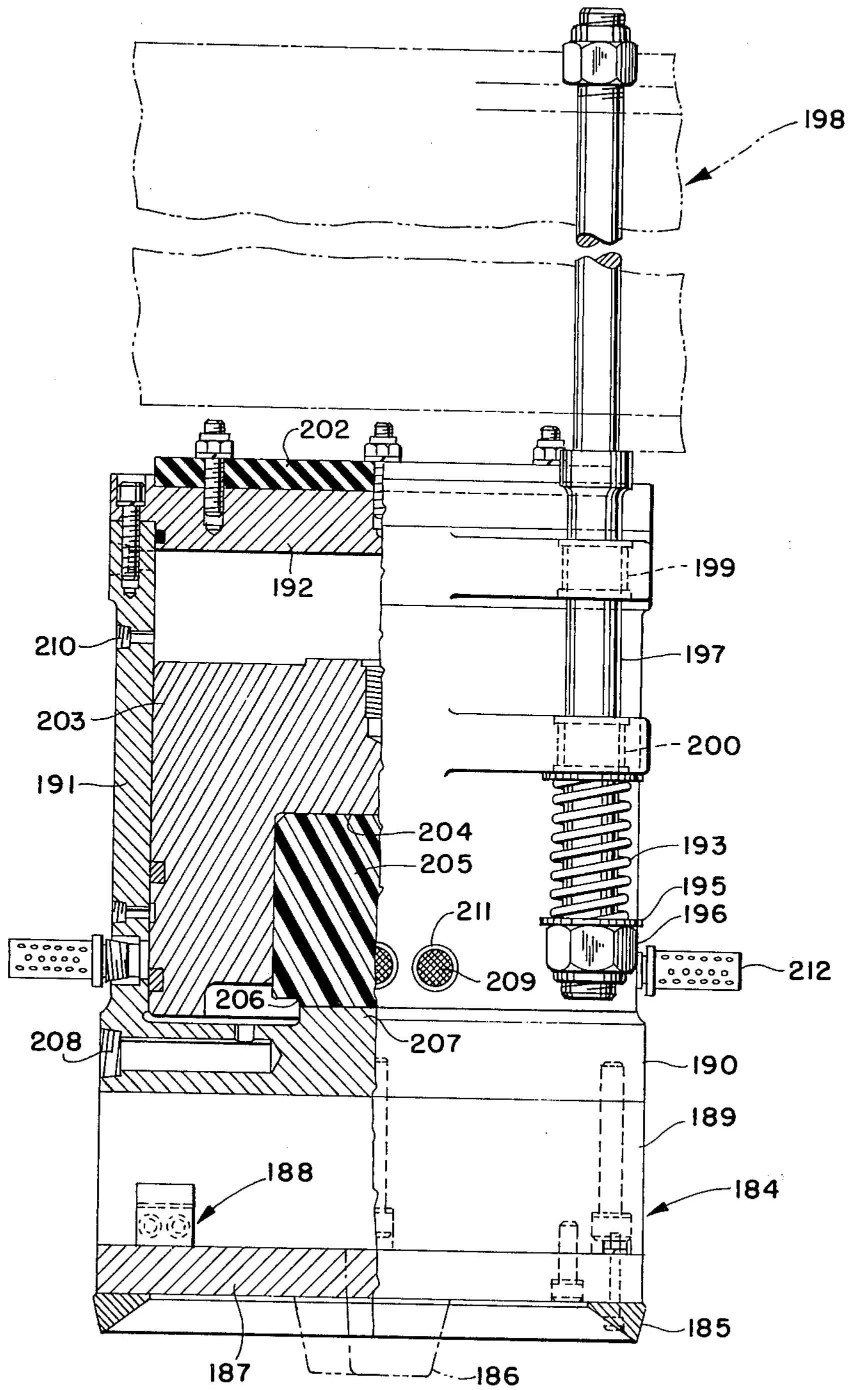
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FIG. 7

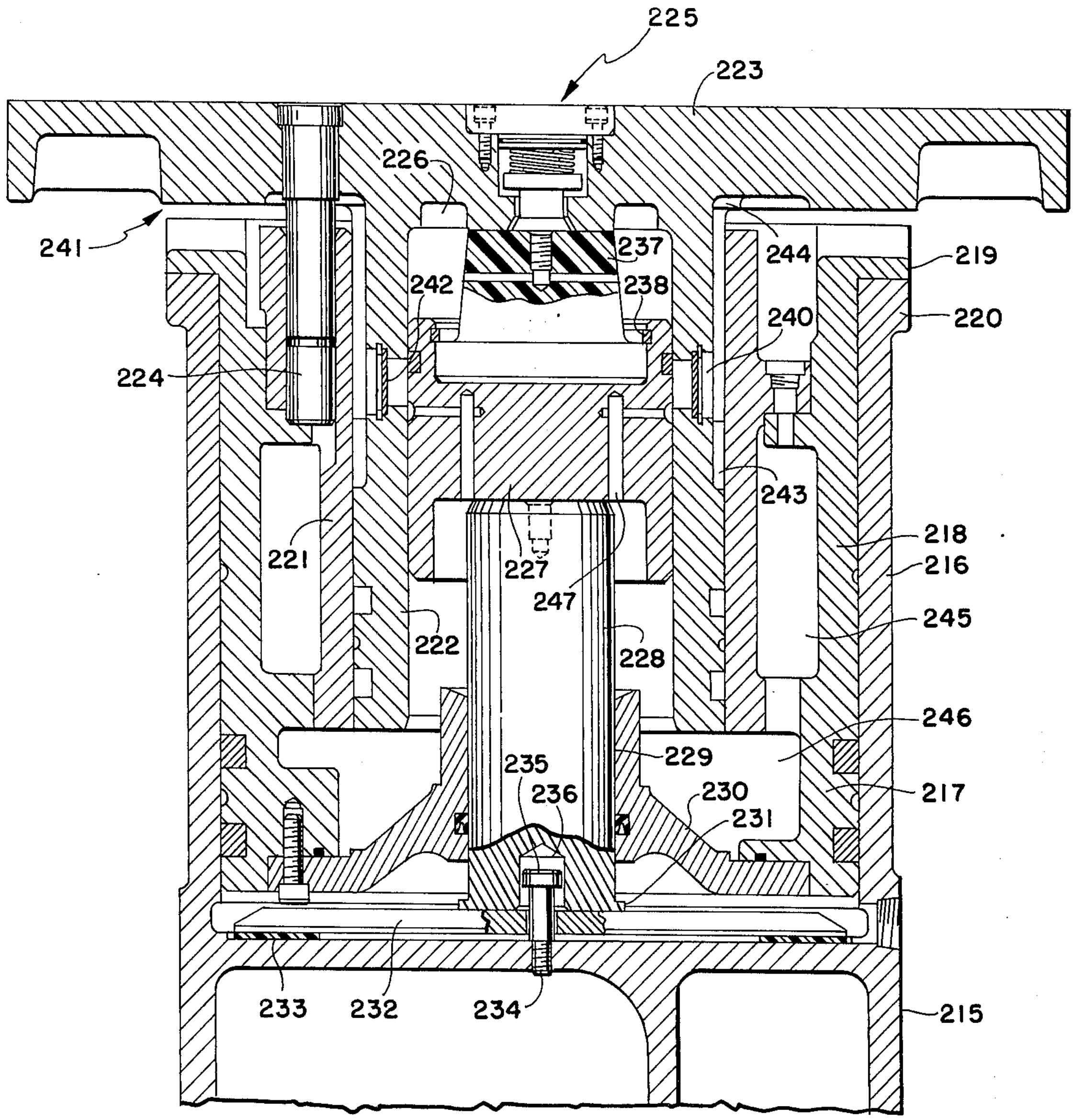
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FIG. 6

SOUND ATTENUATING IMPROVEMENTS FOR FOUNDRY MOLDING MACHINES

This invention relates generally as indicated to sound attenuating improvements for foundry jolt molding machines and more particularly to improvements in the construction of the strike or impact surfaces of such machines as well as improvements in the exhaust and valve systems.

Foundry jolt molding machines normally operate at sound levels in the range of **110** to **130** decibels — "A"Scale (dbA). Most sound in such machines is normally created by two sources, the first being the metal-to-metal strike of the jolt impact, while the second is the air exhaust, air under pressure being required to operate the jolt mechanism and other components of the machine.

Foundry jolt molding machines normally involve relatively moving massive metal parts which impact against each other to obtain the jolt action. Jolt impact surfaces have in the past been provided with wear-resistant, non-metallic coverings. These have not appreciably affected the sound levels of the operation of the machines.

Applicants have found that by providing the jolt impact surfaces of the squeeze ram or jolt ram with specially constructed elastomeric inserts, the noise level attributable to the jolt impact can be significantly reduced while still nonetheless providing sufficient impact forces to obtain dense, firm and uniformly packed foundry molds of the highest quality. In the case of the jolt ram which normally provides a center strike for the sand-filled flask supporting table, a large volume elastomeric insert is provided in the ram to receive the impact. In the case of an annular or outside strike with the table dropping onto the squeeze piston, a relatively large volume elastomeric ring is provided. It has been discovered that the hardness of the elastomeric material utilized should vary inversely to the area of the strike impact. For example, when the strike is on an annular ring, the area of the strike is substantial and the material should normally be fairly soft. Conversely, when the strike is in the center of the table or squeeze head, the area of impact is relatively small and the hardness of the material should be significantly increased. Not only must the hardness and volume of the insert material be carefully controlled but the material itself must be carefully selected to avoid undue softening and wear upon repeated impacting in operation. The volume of the insert is also a factor in dissipating heat resulting from repeated impacting which can cause softening.

In the exhaust system special mufflers or sound filters are employed in conjunction with specially designed porting for the exhaust, the latter preferably leading to an expansion chamber before being ported to atmosphere.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative however, of but a few of the various ways in which the principles of the invention may be employed.

IN SAID ANNEXED DRAWINGS:

FIG. **1** is a fragmentary vertical section of one embodiment of the present invention illustrating a machine providing both an anvil jolt and shockless jolt during squeeze;

FIG. **2** is a fragmentary vertical section taken substantially on the line **2—2** of FIG. **1** illustrating the exhaust expansion chamber in the housing with laterally extending exhaust ports therein;

FIG. **3** is a vertical section of a machine similar to that of FIG. **1** but illustrating a different exhaust porting arrangement for the jolt with the exhaust ports extending through the annular anvil jolt strike ring; the exhaust porting also being connected to the lower chamber;

FIG. **4** is a horizontal section taken substantially on the line **4—4** of FIG. **3** illustrating the arrangement of the exhaust ports in the strike ring;

FIG. **5** is a vertical section taken through the table of a somewhat larger machine of the type which may be used, for example, in automatic lines;

FIG. **6** is a vertical section of a machine having a modified form of squeeze cylinder ram providing both an annular outside anvil jolt and a center strike shockless jolt;

FIG. **7** is a fragmentary vertical section of an overhead squeeze head incorporating a jolt ram and provided with some of the sound attenuating improvements of the present invention; and

FIG. **8** is a vertical section of a machine similar to that of FIG. **6** but utilizing the center strike only for both anvil jolt and shockless jolt during squeeze.

In describing the various embodiments of the present invention particular attention will be paid to the sound attenuating improvements incorporated in the various machines illustrated and the details of such machines will be described only to the extent thought necessary to provide the proper environment for the improvements of this invention.

With reference to FIG. **1** there is illustrated a machine having a base **10** which includes an upstanding cylindrical housing **11** in which is mounted squeeze piston **12.** Such squeeze piston includes an upstanding cylindrical portion **13.** Projecting into the cylindrical extension **13** of the squeeze piston **12** is a cylindrical extension **14** depending from table **15.** The table is adapted to support a sand-filled pattern containing flask. Normally a squeeze head is positionable above the table, such squeeze head engaging the sand within the flask as the table is elevated to form the foundry mold.

Positioned interiorly of the table cylindrical extension **14** is a ram **16** which includes a lower reduced diameter extension **17** which extends through a central opening in the squeeze piston formed by the outwardly extending central cylindrical portion **18.** The extension **17** in the down position of the table is supported on the base **10** and there is provided a slight clearance indicated at **20** between the top of jolt piston and the underside of the table thereabove. The table in such down position is supported solely on the annular top of the cylindrical extension **13** of the squeeze piston. In such down position the squeeze piston **12** is bottomed on the housing **10** as indicated at **21.**

In operation, to obtain an anvil jolt or a dropping of the table against the machine base, air under pressure is supplied through passage **23** in the table which enters chamber **24**. In the down position of the table poppet valve member **25** is in its up position compressing spring **26**, the spring and valve member surrounding poppet guide **27**, the cap **28** of which is secured to the table by fasteners **29**. In the down position of the table the valve member **25** is unseated from the shoulder **30** and accordingly air from the passage **23** will pass into chamber **31** between the ram **16** and the table **15**. When air is thus admitted to the chamber **31** the table is lifted off strike ring **32** on the top of the squeeze piston cylindrical extension **13**. As the table **15** elevates the spring **26** will cause the poppet valve member **25** to move downwardly against the seat **30** closing the air inlet to the chamber **31**. Even though the valve member **25** is closed, the table will continue upwardly due to both the pressure in chamber **31** and the momentum of the table. The table continues upwardly until annular slot **34** in ram **16** communicates with transverse exhaust ports **35** in the table cylindrical extension **14**. The annular groove **34** is in communication with the chamber **31** through a plurality of vertical slots **36**. The exhaust ports **35** in the table cylindrical extension **14** are in communication with vertically elongated shallow groove **37**. Such groove extends downwardly from the exhaust ports **35** and provides communication between exhaust ports **35** and exhaust ports **38** in the squeeze piston cylindrical extension **13**. The exhaust ports **38** communicate with a further elongated groove **40** in the outside face of the extension **13** of the squeeze piston. The purpose of the elongated slot **40** is to provide communication between the exhaust ports **38** and exhaust slots **41** in the housing wall **11**. Such slots **41** are three in number as seen in FIG. 2 and provide communication between the elongated groove **40** and exhaust chamber **42**. The side walls **43** and **44** of the exhaust chamber are provided with enlarged exhaust ports **45** and **46**, respectively, which are covered by exhaust screens or mufflers **47** and **48**, respectively, each of which is secured in place by screen clamp ring **49** which is in turn secured by the fasteners **50**. The exhaust screens or mufflers may be of the compressed metal fiber type which have been found effective to reduce air exhaust noise in combination with the exhaust arrangement shown.

When the annular groove **34** communicates with the exhaust port **35**, air from the chamber **31** will then exhaust to atmosphere through the exhaust chamber **42**. The table then drops onto the strike ring **32**. When the table drops the valve member **25** is again opened repeating the jolt operation as long as the jolt valve is open supplying air pressure through the line **23**. In the illustrated embodiment, the valve member **25** will travel approximately three-eighths of an inch to its closed position while there is approximately **1** inch of travel required to provide communication between the slot **34** in the jolt ram and the exhaust ports **35**. This arrangement reduces the volume of air required to perform the jolt action and accordingly also reduces exhaust noise.

Now, to jolt during squeeze, air is supplied through pipe flange **52** pressurizing the chamber **53** beneath the squeeze piston **12** through passage **54**. This elevates the squeeze piston and of course the table **15** supported on the strike ring **32**. Jolt ram **16** is also elevated by the air pressure within the chamber **53** since the extension **17** thereof is exposed to the pressure within such chamber. This of course will move the jolt ram against the bottom of the table **15** opening the poppet valve member **25**. Again when air is supplied through the passage **23** to the chamber **31** the jolt ram **16** will descend first closing valve member **25** and then providing communication between the slot **34** and the exhaust ports **35** venting the chamber **31**. The squeeze pressure beneath the jolt ram extension **17** will then cause the ram to move upwardly striking the bottom of the table on the underside of the frusto-conical projection **55**. This action will continue as desired as the table is elevated against the squeeze head compressing the sand within the flask supported on the table.

The exhaust system of the machine of FIG. **1** which utilizes: the short stroke poppet **25**; a reduced volume chamber **31** with vertical slots and an annular slot **34** comprising a part of that chamber; a plurality of exhaust ports **35** (in the illustrated embodiment preferably six in number); the exhaust ports **38** and the exhaust slots **41** communicating with the exhaust chamber **42** provided with cover **56**; and the enlarged laterally extending exhaust ports **45** and **46**, has been found effectively to reduce the noise level of such machine caused by the jolt air exhaust. For comparative purposes references may be had to U.S. Pat. No. **3,658,118** to Abraham dated Apr. **25, 1972**, showing an exhaust system of a prior art machine. While all of the above factors are believed to contribute to the reduced noise level, one point of some significance is believed to be the ratio of the cross-sectional area of the exhaust ports **35** as compared to the cross-sectional area of the exhaust ports **45** and **46**. In the illustrated embodiment the latter two provide a cross-sectional area of approximately **14.1** square inches while the cross-sectional area of the six exhaust ports **35** provide a cross-sectional area of approximately **4.7** square inches. This provides an area enlargement in a ratio of approximately three to one.

To reduce the noise level normally generated by the usual metal-to-metal impact of a jolt mechanism, the strike ring **32** is made of a urethane elastomer and includes a mounting ring **58** which is secured to the top of the squeeze piston extension **13** by suitable fasteners **59**. To reduce the noise level of the center strike, the jolt ram **16** is provided at its top with a cavity **61** in which is secured a large volume molded urethane insert **62**. The insert is secured in place by a retaining ring **63** which fits over the shoulder **64** on the insert. The insert is provided with a frusto-conical top projection **65** having the same area as the projection **55** on the table. A tapped aperture **66** is provided in the top of the insert to facilitate the insertion of a lifting eye so that the insert may be readily removed. In the illustrated embodiment the insert **62** may, for example, have a diameter of approximately **6** inches and also a height of approximately **6** inches. Thus the insert is quite massive. The volume of the urethane insert **62** is believed to create some form of heat sink which in combination with the ram structure maintains the insert sufficiently cool to prelude undue softening. For example, a urethane insert pulled after use has felt cold on the outside but the center of the insert was measured at about **200°** Farenheit by the use of a thermocouple. Jolt air passing from the chamber **31** down the vertical slots **36** and into the annular slot **34** apparently extracts heat from the insert, the clearance between the insert and the surrounding jolt ram being just sufficient to insert and remove the insert **62.**

For the center strike insert **62** which has a relatively small strike area it has been found that a relatively high hardness is required of from about **65** to **72** on the Shore D scale and preferably about **70** while the strike ring **32,** having a much larger impact area may have a hardness of approximately **60** to about **95** on the Shore A scale. This is of course relatively soft. With the hardnesses noted it has been found that sufficient impact is still obtained to produce high quality molds while reducing the noise level to less than **90** decibels (dbA). As indicated, normal metal-to-metal impact in such machines generally run from around **110** to **130** decibels (dbA).

The inserts of this and subsequently described embodiments may incorporate suitable heat transfer fillers in suitable amounts (approximately 25–50%). Fillers which have been found to function acceptably are laminar fillers such as aluminum chips, iron or flake aluminum. Also acceptable are graphite granules or coarse bronze wool, for example. It has been found that the insert can be molded in steps with the heat transfer fillers placed alternately between the steps. For example, the uncured elastomer may be poured in the mold to a certain height and then aluminum chips may be layed on top of that portion poured. The pouring and placement of the filler is then alternated until the insert is completely molded. Circular discs of aluminum or copper screen of suitable mesh to permit the elastomer to flow therethrough may be used. In any event, the filler is then confined to vertically spaced horizontal layers. It is believed that such fillers act to absorb and transmit heat from the center of the insert which results from the hysteresis loss of the material. The temperature is of course a factor in the properties of the material and the fillers are believed to maintain the properties at acceptable levels.

In FIGS. **3** and **4** there is illustrated another embodiment of the invention utilizing a different exhaust system to obtain the requisite noise control. In such embodiment the machine includes a housing **70,** squeeze piston **71** mounted therein for vertical reciprocation, table **72** having a cylindrical skirt **73** telescoped into the cylindrical extension **74** of the squeeze piston and jolt ram **75** mounted for vertical reciprocation in the table extension **73.** The jolt ram includes a reduced diameter extension **76** extending through the squeeze piston so that the lower end of the extension **76** is exposed to the chamber beneath the squeeze piston. The jolt ram is provided with a cavity **77** in which is secured the large volume urethane insert **78** while the top of the cylindrical extension **74** of the squeeze piston **71** is provided with urethane strike ring **79** secured through mounting ring **80** by the fasteners **81.**

Air for the jolt action is obtained through the poppet valve assembly **82.** As the table elevates, the air from the chamber **83** above the jolt ram passes downwardly through slots **84** into the annular slot **85** and outwardly through exhaust ports **86** in the table extension **73.**

The exhaust ports **86,** which again may be six in number as in the FIG. **1** embodiment, communicate with an annular groove **87** in the interior of the extension **74** of the squeeze piston **71.** The extension **74** also has a series of vertical grooves **88** therein which extend vertically along the interior thereof, the lower ends communicating with the chamber **89** beneath the table extension **73** and the enlargement of the jolt ram **75.** As seen more clearly in FIG. **4,** three of the vertical slots **88** communicate with paired exhaust ports seen at **91.** Such exhaust ports extend vertically in the annular strike ring **79** and the mounting ring **80** with the latter being utilized to hold muffler screens **92** in place. It will be appreciated that additional exhaust ports may be provided extending vertically through the strike ring **79.** Such exhaust ports will of course be opened as the table is elevated from the strike ring permitting air to escape beneath the relatively shallow skirt **93.** The combination of the muffler screens **92,** which are the same type as employed in the FIG. **1** embodiment, together with the large number of exhaust ports has been found effectively to reduce the air exhaust noise.

One point of note which is illustrated perhaps most clearly in FIG. **4** is that the urethane large volume insert **78** which receives the center strike of the jolt ram is provided with a transverse top slot **94** which precludes an air seal between the ram and the underside of the table.

Referring now to FIG. **5** there is illustrated the head of a jolt and squeeze machine which may be utilized for example in automatic lines. The machine includes a table **96** which is supported on springs, not shown, on vertically movable guide head **97** which is in turn supported on the upper end of tubular piston rod **98.** The piston rod **98** extends through fixed cylinder head **99** from the cylinder **100** of the vertically extending piston cylinder assembly by which the table **96** is raised and lowered.

Jolt guide pins **102** and **103** are secured to the guide head **97** and extend through suitable bushings in both the table and the cylinder head as indicated at **104** and **105,** respectively. A jolt ram **106** includes a lower reduced diameter extension **107** which is spring supported and piloted in the tubular rod **98.** The jolt ram is mounted in cavity **108** in the table and a suitable piston ring is provided indicated at **109.** The table includes a cylindrical skirt **110** formed by the cavity **108.** Air for the jolt is supplied through the poppet valve assembly **111** pressurizing chamber **112.** The chamber **112** includes vertical passages **113** communicating with annular groove **114** so that when the table and ram move relative to each other and the groove **114** is exposed to exhaust ports **115** the chamber **112** will be exhausted. The exhaust ports **115** are closed by plugs **116** and inverted T-passages **117** connect the exhaust ports **115** to chamber **118** through their open legs.

The chamber **118** is formed by ring **119** mounted on annular plate **120** secured to the guide head **97.** The top of the annulus **119** is provided with a beveled ring **121,** the I.D. of which has a rather close clearance with the O.D. of the skirt **110.** The annulus **119** is provided with a plurality of exhaust ports **122** each of which has secured therein muffler screens **123** of the type illustrated in the embodiments of FIGS. **1** and **3.**

Jolt ram **106** is provided with a large volume urethane insert seen at **124** held in place by the retaining ring **125** as in the embodiments of FIGS. **1** and **3.** In this embodiment the insert **124** is provided with two diametrical intersecting passages **126** and **127** at the bottom thereof. Each of the four radially extending passages thus formed is provided with two vertically extending passages as seen at **128** and **129,** or eight such vertical passages altogether. Jolt air from the chamber **112** is accordingly required to pass downwardly through the insert to exhaust through passages **113** during jolt. This accordingly more directly removes heat from the insert which would be generated by repeated jolt impact.

The chamber **118** acts as in the FIG. **1** embodiment as an expansion chamber reducing the exhaust pressure through the ports **122** and together with the muffler screens in a series of exhaust ports substantially reduces the noise level caused by the exhaust. For example, there may be **12** exhaust ports **122** in the annulus **119** thus increasing the cross-sectional area of the exhaust ports by the factor of approximately **3** to **1** indicated above. The machine of FIG. **5** has been found to produce high quality foundry molds with substantially reduced noise levels.

In FIG. **6** the machine includes a table **132** having depending cylindrical extension **133** which fits within cylindrical liner **134** mounted on and secured to shoulder **135** on the interior of the cylindrical extension **136** of the squeeze piston **137**. The cylindrical extension **136** includes a top flange **138** which in the table down position seats on the top **139** of the cylindrical portion **140** of the base **141**.

A jolt ram **143** in the table down position is supported on ram extension **144** which extends through sleeved aperture **145** in the piston **137**. The end of the extension is provided with a lip **146** which precludes the extension from popping through the aperture when the squeeze piston is pressurized.

For jolt action air is admitted from the passage **148** through unseated poppet valve **149** into chamber **150** above the jolt ram. In the table down position, the urethane insert **151** engages the poppet valve member **149** unseating the same. Jolt air pressure in the chamber **150** elevates the table until groove **152** communicates with exhaust ports **153** in the table extension **133** permitting the jolt air to escape into vertical grooves **154**. The vertical grooves **154** are provided with ports **155** communicating with annular chamber **156** which in turn communicates through passages **157** with chamber **158** beneath the table extension **133** and the jolt ram **143**.

The chambers **158** and **156** act as expansion chambers reducing the air pressure impact on exhaust ports **160**, each of which is provided with a muffler screen as indicated at **161**. In the illustrated embodiment of FIG. **6**, there may, for example, be eight such exhaust ports **160**. Such exhaust ports permit the air to escape into chamber **162** and then over the top of the annular strike ring **163** to atmosphere. Radial grooves **164** may be provided in the top of the strike ring to exhaust chamber **162** during simultaneous jolt and squeeze. Such ring is held to the flange **138** of the squeeze piston by fasteners **165** extending through mounting ring **166**.

A jolt guide pin **167** is mounted in table **132** and extends into bushing **168**. A limit pin **169** is mounted in the cylindrical extension **140** of base **141** extending into closed-end slot **170** in the O.D. of cylindrical extension **136** of squeeze piston **137**. The pin **169** precludes over-stroke of the table. Additionally, overstroke ports may be provided in the liner to preclude the table from popping out.

The large volume urethane insert **151** includes a somewhat higher frusto-conical portion **172** than the inserts of the other embodiments, such frusto-conical portion projecting from a cylindrical base **173**; retaining ring **174** engaging the top of the base to hold the insert in place in its cavity. This permits the vertical grooves **175** extending between the chamber **150** and the annular groove **152** to be foreshortened. The insert **151** is also provided with the threaded aperture **176** permitting a lifting eye to be inserted so that the insert may be removed. Transverse passage **177** communicating with the aperture **176** serves the same function as the transverse slot **94** seen in FIG. **4**.

In the operation, with the table down, the table will be jolted on the annular strike ring **163** due to the clearance between the top of the center insert **151** and the underside of the table. At the peak of the strike the compression of the ring **163** may also cause contact with insert **151**. When the squeeze air pressure is supplied through port **179**, the table will be elevated and as the pressure increases to a certain preset value the ram extension **144** will be elevated to the extent permitted by the lip **146**. This will cause the insert **151** to engage the underside of the table and continued jolting during elevation or squeeze is accomplished on the center insert with the ram rebounding due to squeeze air pressure.

It will, of course, be appreciated that the chamber **158** may be pressurized with an imperforate piston **137** and without the extension **144** so that the ram **143** will rebound on a pillow of air within the chamber **158**. To control the pressure within chamber **158**, a pressure control line may be provided through port **157**. Such line may lead to a servo valve which is operative in response to the position of the table **132**.

Referring now to the embodiment of FIG. **7**, there is illustrated a squeeze head against which the sand filled flask is elevated to ram a foundry mold therein. The squeeze head shown generally at **184** includes a peripheral peen strip **185** and a central pouring basin mold imprinter **186**. Both are mounted on plate **187** readily removably secured through brackets **188** to vertically extending plates **189**. Such plates extend downwardly from the bottom **190** of cylindrical housing **191**, the upper end which is closed by plate **192**.

The housing **191** is supported on compression springs **193** supported on washers **195**, in turn on nuts **196**, secured to the lower ends of support rods **197**. Such rods are secured to fixed head frame **198** and extend through bushings **199** and **200** in laterally projecting ears on the cylindrical housing **191**. The top plate **192** of the housing is provided with a FABREEKA pad **202** adapted to engage the underside of the fixed frame **198**. Accordingly, the squeeze head is adapted to move downwardly against the compression of the springs **193**, but is limited in its upward movement.

Inside the cylindrical housing **191** is a large volume jolt ram **203** which is mounted for vertical reciprocation in the housing. The ram is provided with a cavity **204** in which is positioned a large volume elastomeric urethane insert **205** having a projection **206** thereon adapted to engage projection **207** on the squeeze head bottom plate **190**.

To obtain a jolting action, air is supplied through the port **208** to the chamber beneath the ram **203** elevating the same until exhaust ports **209** are uncovered directly exhausting the air beneath the ram. The chamber above the ram may be vented to atmosphere through ports **210**. The ram, of course, traps air above the exhaust ports to assist in rebounding the ram against the squeeze head.

In the illustrated embodiment, there may be 12 exhaust ports 209, some being fitted with muffler screens indicated at 211, while others may be fitted with the cylindrical baffle-type mufflers seen at 212. In any event, the combination of the large number of exhaust ports, together with the mufflers, reduces the exhaust air noise to a satisfactory level while the large volume ram insert 205 reduces the metal-to-metal impact noise normally present.

FIG. 8 is an embodiment of the invention fairly similar to that of FIG. 6, but utilizing the center strike of the table and jolt ram for both anvil jolt and shockless jolt during the squeeze. The machine includes base 215 having upstanding cylindrical housing 216 in which squeeze piston 217 is mounted for vertical reciprocation. The squeeze piston includes an upstanding cylindrical portion 218, the top of which terminates in flange 219 which bottoms on the top of the housing. The squeeze piston includes a liner 221 in which the extension 222 of the table 223 is mounted. Jolt guide pins 224 extend from the table into the liner.

A poppet valve assembly 225 admits air to chamber 226 above jolt ram 227 inside the table extension 222. The jolt ram includes as a separate item extension 228 extending through sleeved aperture 229 in the removable bottom plate 230 of the piston 217. The extension includes a lip 231 precluding the same from popping through the sleeved aperture 229. The extension is supported on large annular spring plate 232 in the down position of the table, the latter being supported on elastomeric ring 233 which may be urethane of a suitable hardness. The plate is held in centered position by a guide pin 234, the head of which precludes the plate from bouncing upwardly excessively or being lifted by squeeze air pressure. The plate is not otherwise held within the machine. The extension 228 is provided with a suitable aperture 236 to provide a suitable clearance between the extension and the guide pin head.

In the down position of the table, the table is supported on the insert 237 secured in the jolt ram 227 by the retaining ring 238. When air is admitted through the poppet valve assembly 225 to the chamber 226 above the jolt ram 227, the table elevates until the exhaust ports 240 are exposed to the chamber, whereupon the table drops providing an anvil jolt impact on the top of the insert 237. The impact is transmitted through the jolt ram to the ram extension 228 and through the large diameter spring plate 232 and the ring 233 to the housing or base 215. The large diameter spring plate, which may be 1090 steel, heat treated, thus absorbs, transfers and distributes the relatively concentrated impact as a smaller load to a much larger area permitting the base to take the repeated impact load.

During squeeze, the squeeze piston 217 elevates to pick up the table at the flange clearance 241. Air pressure beneath the piston also elevates the extension 228 and the jolt ram 227. Jolt during squeeze is obtained in the same manner as in the FIG. 6 embodiment.

Again as in the FIG. 6 embodiment, there may be six such exhaust ports 240, each provided with a muffler screen 242. The exhaust ports lead to vertical grooves 243 in the table extension and the port to atmosphere, as indicated at 244. It will of course be understood that the same exhaust system as provided in FIG. 6 may be used in the FIG. 8 embodiment with the screened exhaust ports being in the liner from an exhaust system also communicating with the chambers 245 and 246, the latter in this embodiment being normally vented through the passages 247. In any event, the urethane insert 237 may be the same as the insert 151 in the FIG. 6 embodiment, and with such large volume insert together with the exhaust system, machines are provided which produce excellent foundry molds at much reduced noise levels.

What is claimed is:

1. In a foundry jolt molding machine having a table adapted to support a sand-filled flask, a pneumatically operated jolt mechanism in said table including a vertically movable jolt ram, the improvement comprising exhaust system porting means for said jolt mechanism progressively enlarging in cross-sectional area towards a plurality of exhaust ports at atmosphere thereby substantially reducing the noise level of the machine, and an expansion chamber in said system between said jolt mechanism and said exhaust ports operative to reduce the pressure of the exhausting air, said expansion chamber being formed in part by a portion of the underside of said jolt ram.

2. A machine as set forth in claim 1 including sound absorbing screens on each of the exhaust ports of such system.

3. A machine as set forth in claim 1 including piston and cylinder means operative vertically to elevate said table, and a further expansion chamber in such system provided exteriorly of the cylinder of said piston.

4. A machine as set forth in claim 3 wherein said further expansion chamber includes two relatively large laterally extending final exhaust ports.

5. A machine as set forth in claim 3 including slot means interconnecting said jolt mechanism and such further expansion chamber at all vertical positions of elevation of said table.

6. A machine as set forth in claim 1 wherein said jolt mechanism includes a cylindrical extension on said table and said jolt ram reciprocally mounted therein, and poppet valve means operative to open by contact between said ram and table, the movement of said poppet valve means being limited to reduce the volume of air required for said jolt mechanism.

7. A machine as set forth in claim 1 wherein the enlargement in cross-sectional area towards the atmosphere is approximately in a ratio of 3 to 1.

8. In foundry jolt molding machine, having a vertically movable table, means to elevate said table and then drop the same to obtain a jolt strike, the improvement comprising an elastomeric sound attenuating insert means against which said table is dropped, the hardness of said insert means being inversely related to the area of the strike thereagainst.

9. A machine as set forth in claim 8 wherein said insert means includes a heat absorbing and transmitting filler material.

10. A machine as set forth in claim 8 wherein said elastomeric sound attenuating insert means includes an annular ring having a large impact area, said ring being relatively soft.

11. A machine as set forth in claim 10 wherein said ring has a durometer hardness on the Shore A scale of approximately 60 to about 95.

12. A machine as set forth in claim 8 wherein the said elastomeric sound attenuating insert means including an insert in the center of the table and has a relatively small strike area, said insert being relatively hard.

13. A machine as set forth in claim **12** wherein said insert has a durometer hardness on the Shore D scale of approximately **70.**

14. A machine as set forth in claim **8** wherein said insert means includes an insert of solid polyurethane of substantial volume.

15. A machine as set forth in claim **8** wherein said insert means includes an insert of solid polyurethane of substantial volume, and means operative to cool said insert by the passage of machine exhaust air thereadjacent.

16. A machine as set forth in claim **8** including a reciprocable jolt ram in the center of the table, said insert means including an insert mounted in the end of said ram facing said table and projecting from said ram to receive the table strike thereagainst.

17. A machine as set forth in claim **16** wherein said insert is a large volume of solid polyurethane held in place by a retaining ring.

18. A machine as set forth in claim **8** including air passages extending through a part of said insert means for cooling the same.

19. In a foundry jolt molding machine comprising a table and jolt ram mounted for relative movement to obtain jolt impact, the improvement comprising a large volume elastomeric insert in said jolt ram to receive the impact, whereby such machine will operate to produce high quality foundry molds at reduced noise levels, said table and jolt ram being air operated to obtain such jolt impact, and means to pass such air adjacent such insert to prevent overheating the same.

20. A machine as set forth in claim **19** wherein said insert is solid polyurethane having a hardness of approximately **60** to **75** on the Shore D scale.

21. A foundry jolt molding machine comprising a table and a jolt ram mounted in said table for relative movement, means to pressurize the end of the ram facing the table relatively to move said ram and said table, means to vent the pressurized end of said ram through a plurality of exhaust ports to bring the table and ram together for a jolt impact, such ram having a large volume elastomeric insert therein to receive the jolt impact, whereby such machine will operate to produce high quality foundry molds at a noise level of less than **90** dbA (A scale), said chamber formed by the end of the ram facing the table and including a plurality of passages adjacent the insert to facilitate the dissipation of heat therefrom.

22. A machine as set forth in claim **21** wherein said insert is solid polyurethane having a hardness of approximately **70** on the Shore D scale.

23. In a foundry jolt molding machine, having a vertically movable table, means to elevate said table and then drop the same to obtain a jolt strike, the improvement comprising an elastomeric sound attenuating insert means against which said table is dropped, the hardness of said means insert being inversely related to the area of the strike thereagainst, said elastomeric sound attenuating insert means including an annular ring having a large impact area, said ring being relatively soft, and exhaust air ports extending through said annular ring.

24. A machine as set forth in claim **23** including muffler screens in said exhaust air ports.

25. In a foundry jolt molding machine comprising a table and jolt ram mounted for relative movement to obtain jolt impact, the improvement comprising a large volume elastomeric insert in said jolt ram to receive the impact, whereby such machine will operate to produce high quality foundry molds at reduced noise levels, and an exhaust system porting means for said table and jolt ram progressively enlarging in cross-sectional area towards atmosphere thereby substantially reducing the noise level of the machine.

26. A machine as set forth in claim **25** including an expansion chamber in such exhaust system to reduce the air pressure of the exhaust.

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