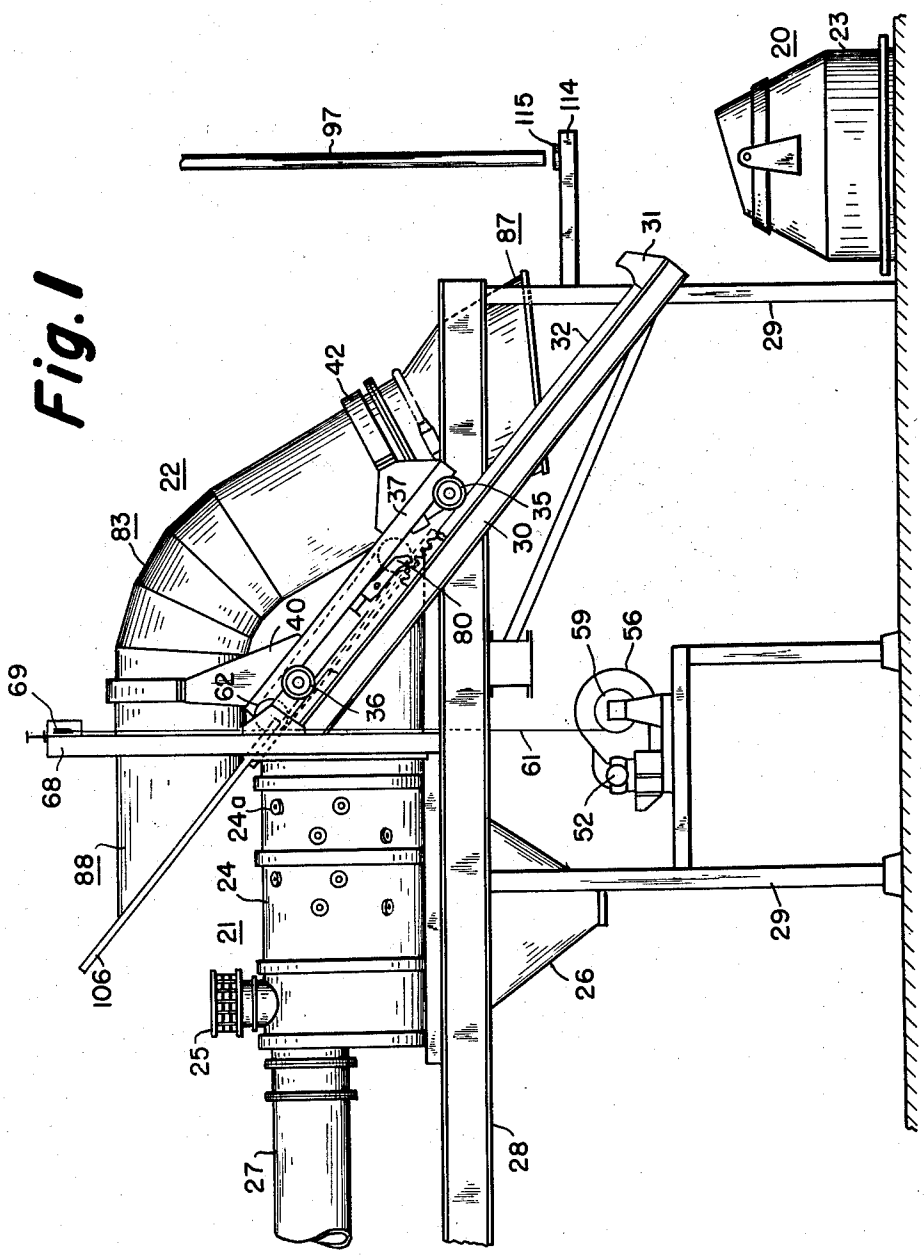
Aug. 12, 1958 H. L. McFEATERS 2,847,206

EXHAUST APPARATUS

Filed June 20, 1955 6 Sheets-Sheet 1

Fig. 1



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EXHAUST APPARATUS

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Fig. 2

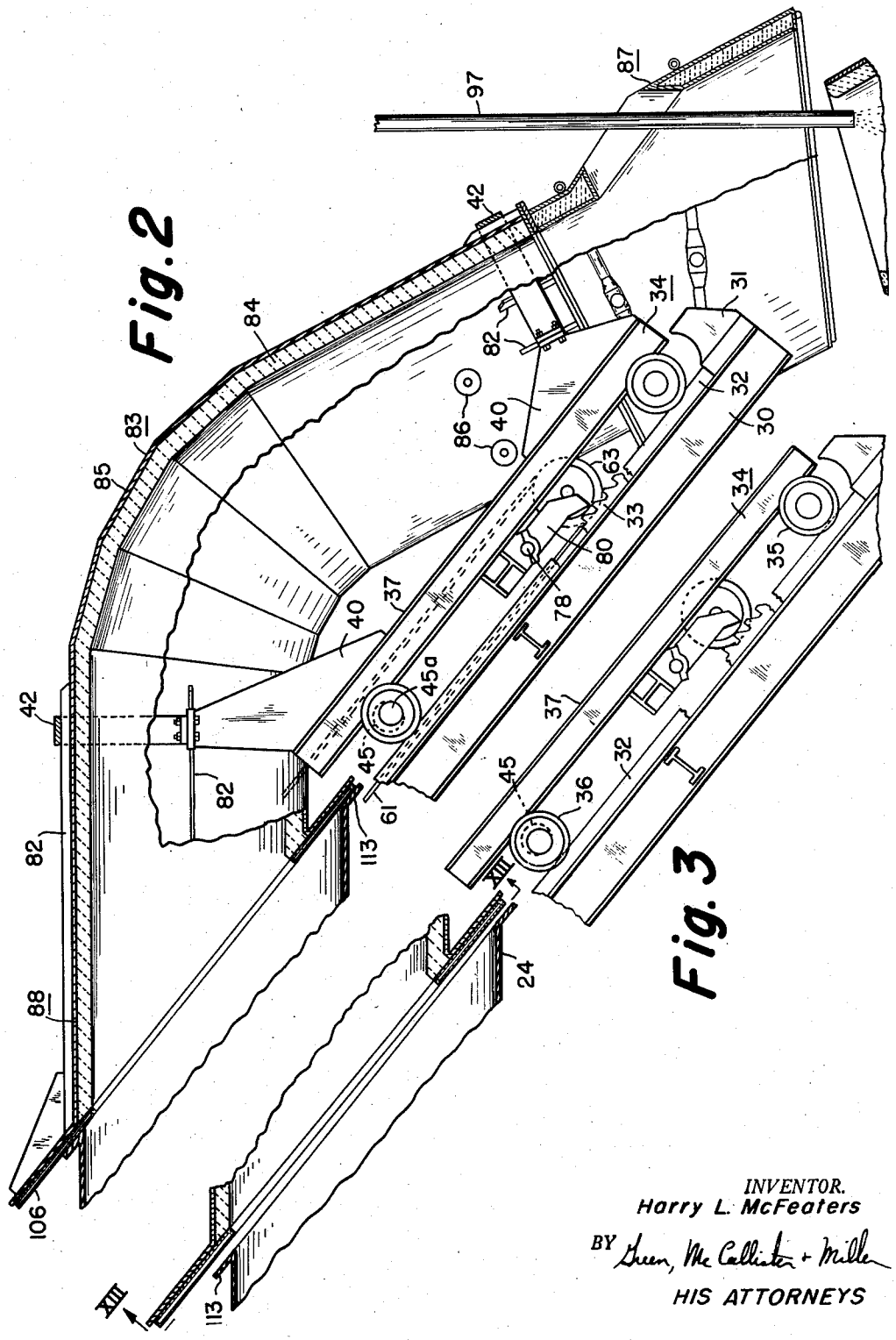


Fig. 3

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EXHAUST APPARATUS

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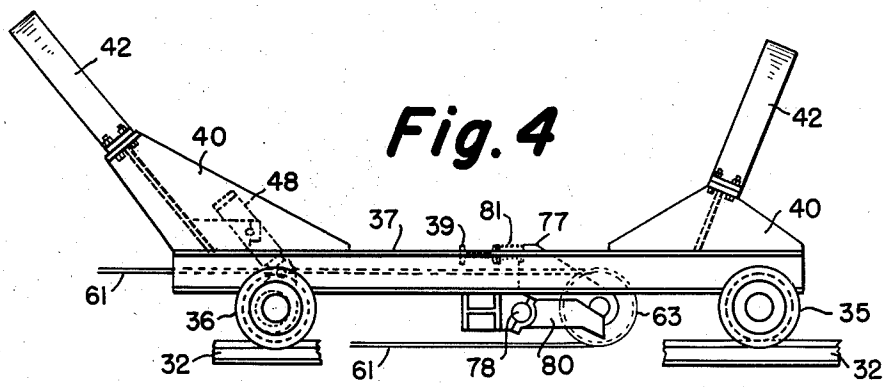


Fig. 4

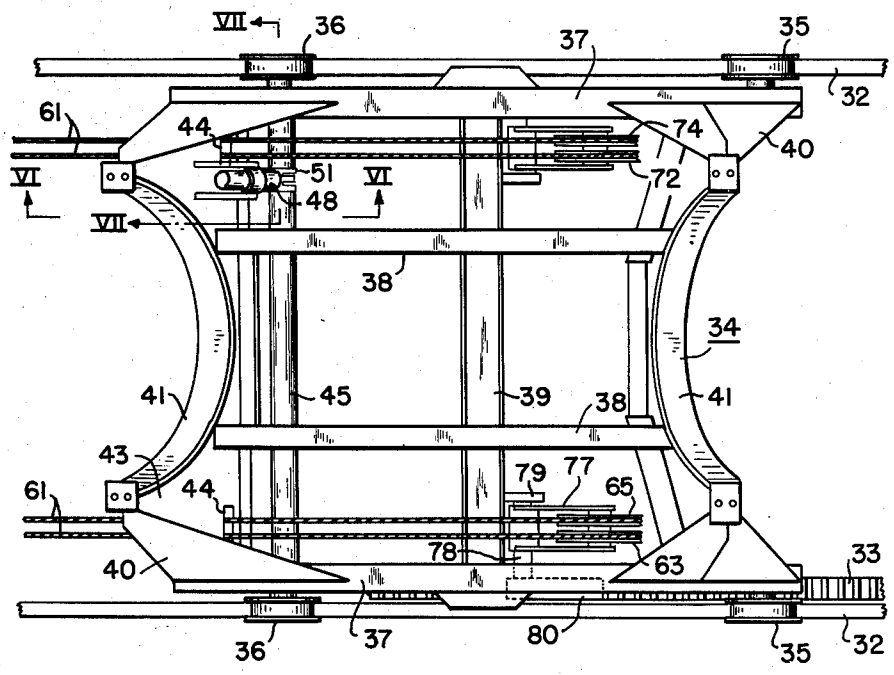


Fig. 5

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EXHAUST APPARATUS

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Fig. 7

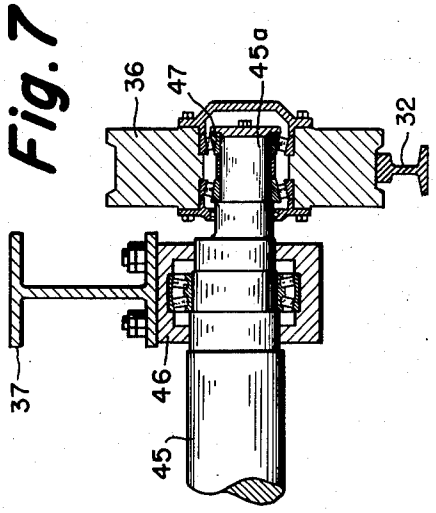


Fig. 8

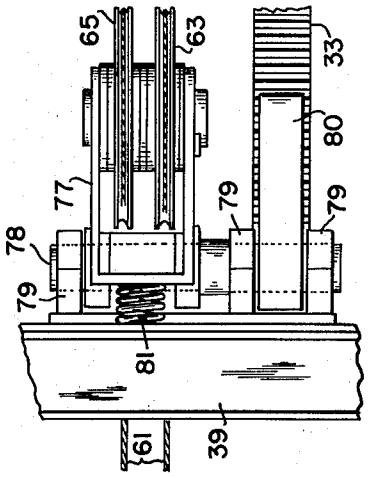
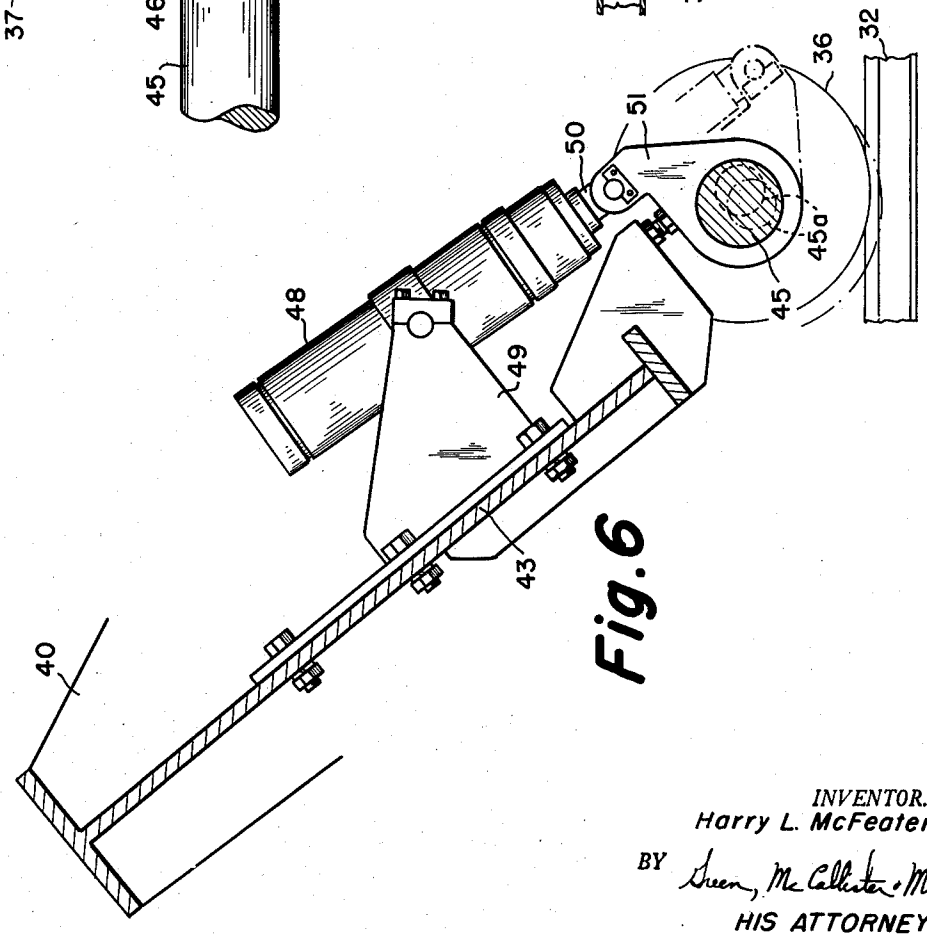


Fig. 6



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EXHAUST APPARATUS

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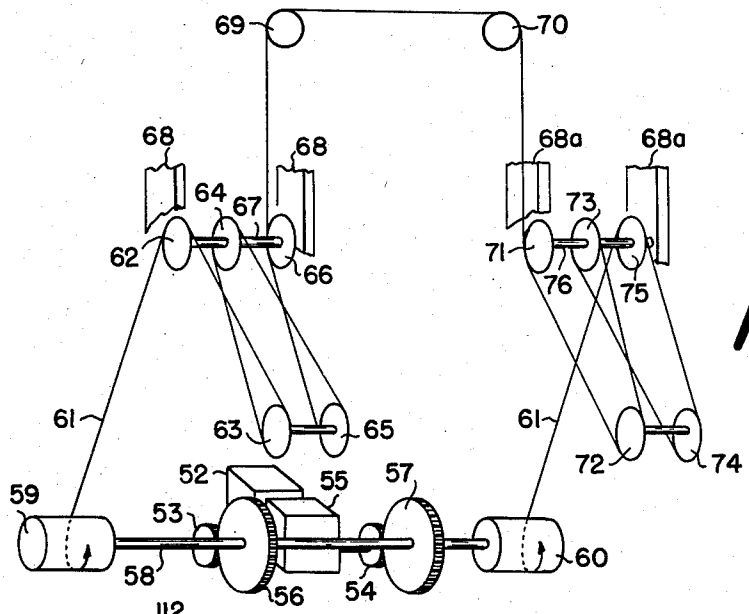


Fig. 9

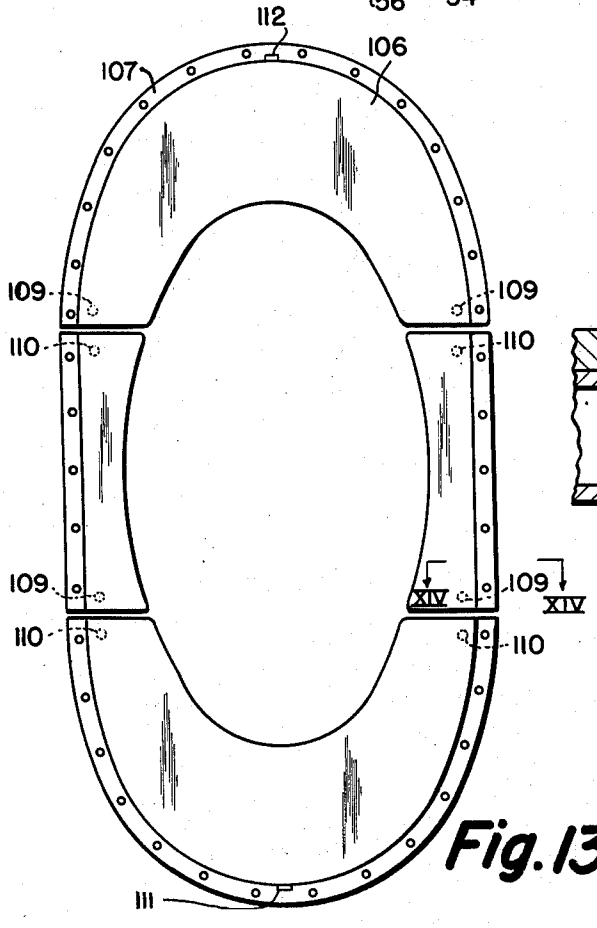


Fig. 13

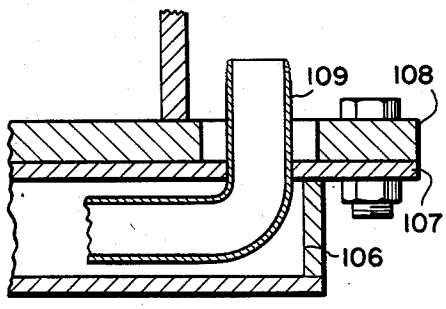


Fig. 14

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EXHAUST APPARATUS

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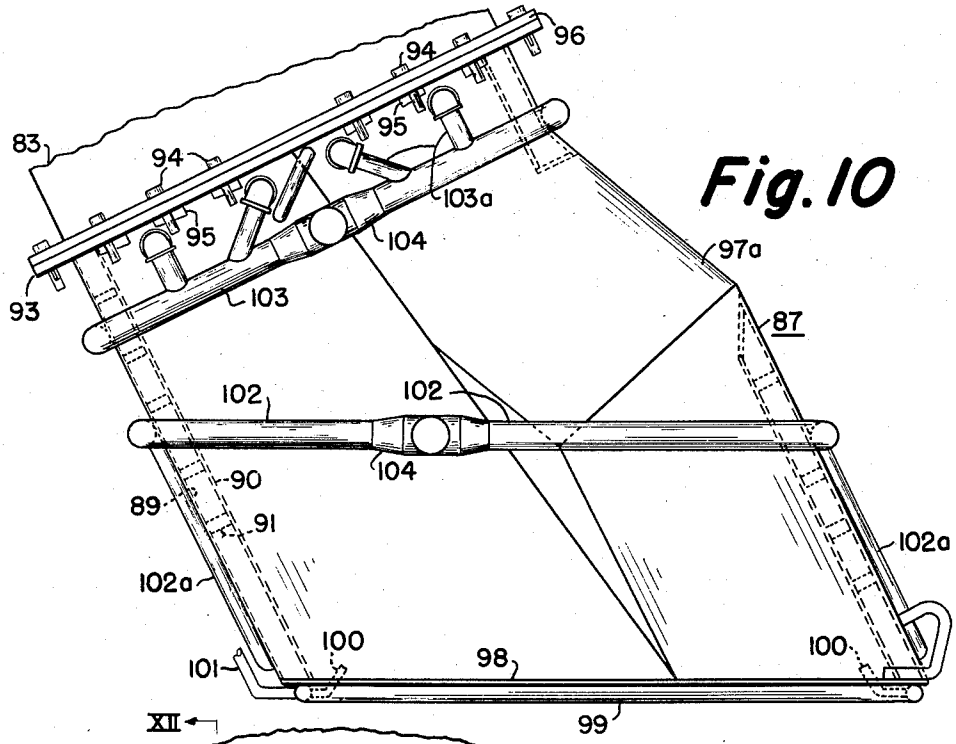


Fig. 10

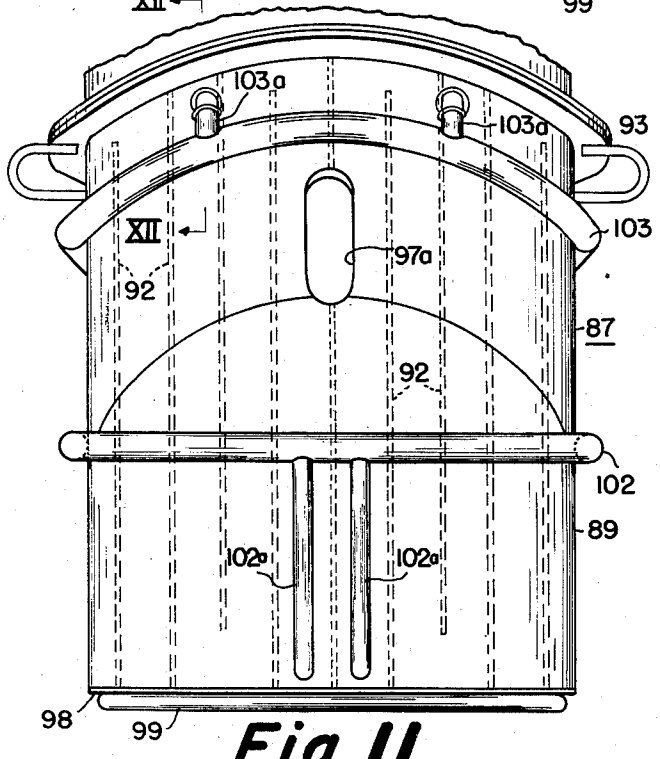


Fig. 11

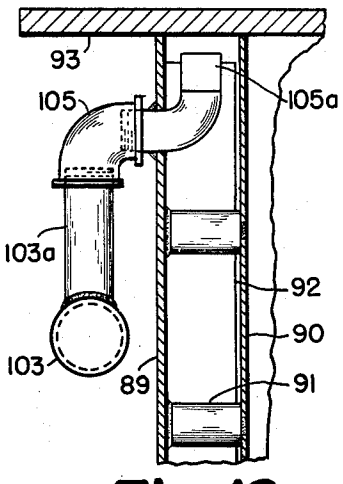


Fig. 12

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United States Patent Office

2,847,206

Patented Aug. 12, 1958

2,847,206

EXHAUST APPARATUS

Harry L. McFeaters, New Castle, Pa., assignor to Pennsylvania Engineering Corporation, New Castle, Pa., a corporation of Pennsylvania

Application June 20, 1955, Serial No. 516,597

19 Claims. (Cl. 266—35)

The present invention relates to exhaust apparatus and more particularly to apparatus for exhausting fluids or gases from a converter in an oxygen process of steelmaking.

For many years, steel has been produced by the Bessemer process wherein air is blown upwardly through a molten charge of iron and impurities contained in a converter. Although this process produces steel quickly and inexpensively, the product has limited uses. As the needs for steel become more diversified, the types and varieties required have likewise undergone diversification. Because of its relative inflexible operation, the Bessemer process cannot produce many of these steels.

Of more recent years, the requirement for an inexpensive, fast method of producing different varieties of steel has been met by the so-called oxygen process of steelmaking. This process may be regarded as a modified Bessemer process in that instead of air, relatively pure oxygen is used and the oxygen is ordinarily fed downwardly into a converter or crucible through a lance tube which is inserted vertically therein.

In an oxygen process there is a considerable evolution of gases. Because of their extremely high temperature of the order of 3200° F. or higher, the amount of smoke and flame involved, and the corrosive tendencies of some impurities which may be present, the disposition of the evolved gases presents a problem in commercial installations. The gases must be conducted safely away from the converter area and must be cooled for cleaning processing. The exhaust apparatus employed must be capable of being operatively positioned sufficiently close to the converter to be able to accomplish these functions, and yet such apparatus cannot block access to the converter since a certain area of free movement must be available about and over the converter for charging and emptying it, etc.

The present invention relates to hood or exhaust apparatus constructed to meet the problem. My apparatus conducts and cools effluent fluids or gases safely from a position in close proximity with the converter and discharges into an exhaust conduit. It may be readily removed or reciprocated to a non-interfering position to permit charging and other operations to be conveniently performed about the converter. The apparatus of my invention includes additional features, in that it facilitates a union between its hood and an exhaust conduit and has a safety latch or hold, should the normal means for moving the hood fail. I also provide for the conjoint use of my exhaust apparatus with a lance tube.

Summarized briefly, I provide apparatus for directing and conditioning an effluent fluid discharge which will normally be in relatively great volume and of relatively high temperature and will contain dust, smoke, fumes, etc. The apparatus has been constructed to operate in a practical and efficient manner in cooperation with the mouth, discharge port or end of a generator such as a converter or other vessel within which metal is being melted or conditioned, as by a so-called oxygen-blow process.

The apparatus consists essentially of an enclosing shell assembly or hood which is provided with means for advancing and retracting it into and out of a cooperating flame and fume-receiving relationship with the mouth of the vessel to receive, cool, and direct the effluent gases or hot fluids through an exhaust or discharge conduit or means into a receiving means or preliminary cleaning device, such as a spark trap, from which they may be conducted into a suitable final cleaning apparatus. Since the volume of gases may be relatively large, e. g., in the neighborhood of 156,000 cubic feet per minute at the mouth of a 25-ton converter, it is important to provide an apparatus that will effectively cloak or enclose and at the same time, quickly cool the fluids and gases while conducting them upwardly into the discharge or exhaust means.

I prevent damage to the hood of my apparatus and efficiently cool the effluent gases by jacketing it and continuously flowing a cooling fluid, such as water, therethrough. The jacketing is accomplished by employing radially spaced-apart shells, circuitous-passageway-defining, rib or web baffles along the spacing, and connecting chest or tubing portions. Spray jet means is directed into the path of the effluent fluids through the hood.

It is important that when the hood is in its operating or fluid-receiving position, that its other end have a good sealed relationship with respect to apparatus into which it discharges. It is also important to facilitate the operative movement of the hood without requiring intricate means for sealing and releasing the hood at its discharge end. I have been able to meet these factors.

The hood is mounted on a carriage and is provided with cable reeving that is motor-driven for raising it and lowering it in a positive manner on a runway. A safety latch means prevents the carriage from falling away and instantaneously acts in the event of any failure of the reeving.

In the form illustrated, my apparatus includes a tubular exhaust hood mounted on a carriage. The carriage travels on a runway to reciprocate the hood between operative and inoperative (lower and upper) positions. In the operative position, the hood has a forward end disposed about the converter and a rearward end engageable with an exhaust conduit. For this purpose, the rearward end of the hood and the adjacent end of the exhaust conduit have mating sections. The ends of the hood are shown as water cooled, and the rearward end of the hood may be elevated with respect to the adjacent end of the exhaust conduit while the hood is otherwise stationary, so as to permit subsequent translational movement between those ends and facilitate seating one end against the other.

A cable trained around sheave means on the carriage reciprocates the carriage on the runway. The sheave means may be carried in a bracket pivoted on the carriage. A pawl which pivots with the bracket is engageable with a rack disposed along the runway. Normally, the pull of the cable on the sheave means raises the bracket about its axis of rotation. The failure of the cable, however, permits the bracket to fall and the pawl to engage the rack and thereby hold the carriage on the runway. The forward end of the hood is also shown provided with a by-pass opening to admit a lance tube therethrough to reach into the converter.

The accompanying drawings illustrate a presently preferred embodiment wherein:

Figure 1 is a side view of my exhaust apparatus as it may be used in the oxygen process for making steel with its hood in a raised position;

Figure 2 is an enlarged side view, partially in section, of the hood of Figure 1 in a lowered position;

Figure 3 is a partial side view of the apparatus of

Figure 2 illustrating a carriage and rearward end of the hood in an elevated position with respect to an exhaust conduit;

Figure 4 is a side view of the carriage with the hood removed;

Figure 5 is a plan view of Figure 4 with upper straps removed;

Figures 6 and 7 are sections of Figure 5 and on the lines VI—VI and VII—VII, respectively;

Figure 8 is an enlarged plan view of sheaves of Figure 5 with a carriage frame removed to show a pawl;

Figure 9 is a diagrammatic view of a cable system which reciprocates the carriage on the runway;

Figure 10 is a side view of a forward end of the hood;

Figure 11 is a right-hand view of Figure 10;

Figure 12 is a section of Figure 11 on the line XII—XII;

Figure 13 is a section of Figure 3 on the line XIII—XIII; and

Figure 14 is a section of Figure 13 on the line XIV—XIV.

Although the exhaust apparatus is disclosed in connection with the oxygen process for steelmaking, it may be used for similar purposes in other processes. Referring to the drawings, the embodiment disclosed comprises a generator vessel or converter **20**, an exhaust conduit, discharge or exhaust receiver generally shown at **21**, and a hood or exhaust apparatus generally indicated at **22** which moves in and out of operative relationship with the converter and the exhaust conduit. The converter is of usual construction and includes an outer shell **23** lined with refrectory brick and trunnion mounted (not shown) to permit emptying. The exhause conduit or receiver **21** includes a spark trap **24** having nozzles **24***a*, an explosion valve **25**, a clean-out chute **26**, and a pipe **27**, all of which are suitably supported on side beams **28** and posts **29** which straddle the exhaust apparatus.

The exhaust apparatus includes an inclined runway or guideway composed of support members or beams **30** which extend toward a mouth or discharge port of the converter **20** and terminate in roller stops **31**. The beams carry rails **32** and a rack **33**. A carriage generally shown at **34** (Figure 5), has rollers **35** and **36** that ride on the rails. The carriage includes (see Figure 5) side frames **37**, reinforcing beams **38**, and a cross-beam **39**. At the corners of the carriage, standards **40** support a transverse cradle strap **41** to which an upper strap **42** may be bolted. A frame of sheet of metal **43** is fixed to and underlies the rearward cradle strap and has openings **44** to pass a cable, hereinafter described.

The forward rollers **35** are individually journaled in the side frames **37**, but the rearward rollers **36** are mounted on a shaft **45** (Figure 7) which is designed to elevate the rearward end of the carriage. The shaft, itself, is carried in underslung bearings **46** mounted beneath the side frames **37**. Aligned stud shafts **45***a* are eccentrically placed at each end of the shaft **45** on which the rollers **36** are free to rotate by means of bearings **47**. A double-acting or reciprocating hydraulic cylinder **48** (Figure 6) of conventional construction actuates collar **51** to rotate the shaft, when desired, through preferably about 90 degrees. The cylinder is trunnion mounted on a bracket **49** which is bolted to the frame **43**. The piston rod **50** of the cylinder is pivotally connected to a collar **51** that is fixed to the shaft **45**.

A cable system reciprocates the carriage on the runway. As shown in Figures 1 and 9, a reversible motor **52** drives pinions **53** and **54** through a gear reducer **55**. Pinions drive gears **56** and **57** and are fixed to a shaft **58** having end winches **59** and **60**. One end of the cable **61** is reeved on and passes upwardly from the winch **59** and then, in turn, over sheaves **62**, **63**, **64**, **65**, and **66**. Sheaves **62**, **64**, and **66** are journaled by shaft **67** on posts **68** (see Figures 1 and 9), while sheaves **63** and **65** are journaled on the carriage **34** (Figures 5 and 8). The cross-beam **39** has suitable openings to pass the cable **61**. From sheave **66** the cable travels around passover sheaves **69** and **70** and then, in order, around sheaves **71**, **72**, **73**, **74**, and **75** to terminate or reeve at its other end on winch **60**. Sheaves **71**, **73**, and **75** are journaled by shaft **76** on posts **68***a* that are stationed on the other side of the carriage, and sheaves **72** and **74** are also journaled on the carriage.

The carriage **34** includes a safety catch to hold it on the runway should the cable **61** fail. At least sheaves **63** and **65** are journaled in a bracket **77** (Figure 8) which is fixed to a shaft **78** that is journaled in bearings **79**. The bearings in turn are supported by the cross-beam **39**. A pawl **80** is fixed on the shaft **78**, so that in combination with the sheaves **63** and **65**, the bracket **77** is weighted to rotate clockwise as viewed in Figure 4. The pull of the cable **61** on the sheaves, however, maintains the bracket **77** in a raised position against tension of a coil spring stop or abutment **81**. Should the cable fail, the bracket **77** pivots downwardly to engage the pawl **80** with a rack **33** and retain the carriage **34** at its selected position on the runway.

As shown in Figure 2, cradle straps **41** and upper straps **42** embrace ribs **82** of a tubular hood **83** lined internally with refractory brick **84**. The hood has a centrally curved section **85** that preferably includes nozzles **86** at its lower portion through which water may be injected for cooling purposes, and terminates in a forward end **87** and a rearward end **88**.

The forward end (see Figures 10 through 12) comprises concentric (inner and outer) metal shells **89** and **90** spaced by pins **91** which are welded to the shells. Radially-disposed baffles **92** extend around the forward end **87** between the shells **89** and **90** and, as shown in Figure 11, are suitably staggered from the opposite closed ends of the shells to permit a coolant passing between the shells to reverse its direction of flow. Preferably, the baffles **92** are fixed to one shell and spaced somewhat from the other as shown in Figure 12. A flange **93** seals the annular area between the shells at the upper end, and king bolts **94** and wedges **95** secure flange **93** to a mating flange **96** of the hood **83**. At one side, the shells have an offset portion provided with an opening **97***a* to receive a lance tube **97**. A flange **98** seals the annular area between the shells at their lower ends. A tube **99** fixed to flange **98** has nozzles **100** spaced along the tube for directing a coolant into the shell **90**. A pipe **101** supplies the coolant to tube **99**.

Pipes **102** and **103** encircle the forward end **87** and receive a coolant through T fittings **104**. These fittings are connected to suitable piping or flexible hose, not shown. Pipe **102** has tubes **102***a* downwardly spaced around the periphery of the outer shell **89**. These tubes pass through the outer shell by means of a suitable elbow connection to feed a coolant between the shells. Pipe **103** has tubes **103***a* that are upwardly spaced around the periphery of the outer shell **89**. Tubes **103***a* pass through shell **89** by means of an elbow connection **105** (Figure 12) to provide an exit for the coolant after it has reached the area around a nipple **105***a* adjacent the flange **93**.

The rearward end **88** of the hood terminates in a transverse section which mates with a similar transverse section of the inlet end of the exhaust conduit **21**. Because of the travel of the hood, these mating sections are angularly related with the vertical and substantially parallel to each other and to the direction of travel. The transverse section of the rearward end **85** includes a hollow metal cooling ring slide contact flange or sealing lip **106** of four sections (Figure 13 and 14). A flange **107** of each section is bolted to a flange **108** of the hood; these flanges having openings (as shown in Figure 14) to admit inlet elbows or nipples **109** and outlet elbows or nipples **110**. An inlet nipple **111** and an outlet nipple **112** for the upper and lower sections, respectively, enter those sections from their outer edges. These nipples and elbows circulate a coolant such as water

through the sections of ring **106** in a manner similar to that described for the forward end **87**.

In operation, the exhaust apparatus may initially be in a retracted position shown in Figure 1. After the converter is charged, the motor **52** and cable **61** lower the carriage 34 on the runway. At this time, shaft **45** is in the position shown in Figure 7, so that there is a spacing between the rearward end of the hood and the inlet end of the exhaust conduit as illustrated in Figure 3. This facilitates the translational movement of one end past the other and avoids any interference therebetween. When the forward end **87** suitably encompasses the mouth or discharge port of the converter **20**, the motor **52** is stopped and cylinder **48** is actuated to turn the shaft 45 about 90 degrees. This raises the stub shafts **45***a* and has the effect of lowering the carriage and hood and thereby seat the cooling ring **106** of the rearward end of the hood against a slide contact flange, sealing lip or ring **113** of the exhaust conduit or receiver (Figure 2).

I wish to emphasize that there is an operational range through which the hood may be moved relatively to the exhaust conduit or receiver without breaking the continuation of the hood with the inlet portion of the conduit. Thus in Figure 2, the hood is shown approximately at its highest operating position with respect to the spark trap 24 of the exhaust conduit. Should it be desired to adjust the position of the hood, the latter may still be lowered or raised enough through the allowable widths of the upper and lower sections of the cooling ring **106** without breaking the seal between the hood and the exhaust conduit.

The lance tube **97**, as guided by converging beams **114** and funnel **115**, is now inserted through the opening **97***a* of the forward end and into the converter to charge the oxygen. During the ensuing "blow," the exhaust or effluent gases are safely carried through the hood **83** and out of exhaust conduit or receiver **21**. At this time, the forward end **87**, the tube **99** and the sections of ring **106** are water cooled. Water may also be injected through the nozzles **24***a*, **86**, and **100** into the trap 24 and hood **83**. As an example, the gases may be brought from a temperature of about 3200° F. to about 500° F. This also precipitates particles from the gases which fall into or deposit in the clean-out chute **26**. After completion of the "blow," tube **97** may be withdrawn and shaft **45** rotated to elevate the rearward end of the hood with respect to the exhaust conduit or discharge-receiving means. The hood may then be retracted to its original, upper position. As a safety measure, should the cable **61** fail at any time, the bracket **77** drops to engage the pawl **80** with the rack **33**.

While the foregoing disclosure describes a presently preferred embodiment, it is understood that the invention may be practiced within the scope of the following claims.

I claim:

1. Apparatus for receiving a hot fluid effluent from the mouth of a generator such as a converter and for conducting the effluent to a discharge-receiving means including an enclosing hood defining an effluent passageway therethrough and open at its lower end to receive the effluent from the mouth of the generator, said hood being open at its upper end to discharge the effluent therefrom into the discharge-receiving means, and means for moving the upper end portion of said hood into and out of a registry with the discharge-receiving means, while moving its lower end portion into and out of a cooperative effluent-receiving relationship with the mouth of the generator.

2. Apparatus as defined in claim 1 wherein a sealing means is associated with the upper end portion of said hood to maintain said hood in a connected relation with the discharge-receiving means during a preliminary portion of its movement out of and a final portion of its movement into the effluent-receiving relationship with the mouth of the converter.

3. Apparatus as defined in claim 1 wherein means is operatively associated with said hood to raise its upper end portion with respect to its front end portion to facilitate movement of the upper end portion out of registry with the discharge-receiving means.

4. Apparatus as claimed in claim 1 wherein said upper end of the hood terminates in a hollow flange and includes means for passing a coolant therethrough.

5. Apparatus as defined in claim 1 wherein, cooling fluid jacket portions extend along the longitudinal extent of a lower portion of said hood, and inlet and outlet means is connected to said jacket portions to supply cooling fluid to and remove warmed fluid from said jacket portions.

6. Apparatus as defined in claim 1 wherein, said hood has cooling fluid jacketing, a jacket ring about the lower end portion of said hood, and spray means connected to said jacket ring to direct a cooling fluid spray upon the effluent entering said hood from the generator.

7. Apparatus as defined in claim 1 wherein said hood has at one end portion concentric shells, means to space the shells from each other, means to seal the ends of the shells to each other, baffles disposed substantially longitudinally between the shells, a coolant-delivering pipe extending around the outer shell, a conduit extending from said pipe to a delivery station between the shells adjacent a lower end thereof, a coolant-exiting pipe extending around the outer shell, and a conduit extending from the last-mentioned pipe to an exit station between the shells adjacent an upper end thereof.

8. Apparatus as claimed in claim 1 wherein the upper end of the hood and the entrance to the discharge-receiving means are complementary to form a continuation of the hood and have flanges paralleling each other to permit relative movement between the hood and the discharge-receiving means within the widths of the flanges without breaking said continuation of the hood.

9. Apparatus as defined in claim 1 wherein, said hood has at one end portion a pair of radially spaced-apart shells defining a cooling spacing therebetween, means enclosing end portions of the spacing, and means for supplying cooling fluid to and removing warmed fluid from the spacing.

10. Apparatus as defined in claim 9 wherein baffle means defines circuitous cooling fluid passageways along the spacing from said last-mentioned means.

11. Apparatus as defined in claim 10 wherein, the generator is supplied with oxygen through a vertically-extending supply lance, and said hood has a through-port portion sealed off from its jacket portions to receive and by-pass the supply lance therethrough into the mouth of the generator.

12. Apparatus for receiving a hot fluid effluent from the mouth of a generator such as a converter and for conducting the effluent to a discharge-receiving means including an enclosing hood defining an effluent passageway therethrough and open at its lower end to receive the effluent from the mouth of the generator, said hood being open at its upper end to discharge the effluent therefrom into the discharge-receiving means, means for moving the upper end portion of said hood into and out of registry with the discharge-receiving means, while moving its lower end portion into and out of a cooperative effluent-receiving relationship with the mouth of the generator, an inclined runway leading between the generator and the discharge-receiving means, a carriage operatively positioning said hood on said runway, and said means for moving being operatively connected with said carriage.

13. Apparatus as defined in claim 12 including an axle mounted on the carriage adjacent the rearward end of the hood, means to space the axle from the runway, and means to raise and lower the axle with respect to the carriage to elevate the rearward end of the hood relative to the discharge-receiving means and permit translational movement therebetween.

14. Apparatus as defined in claim 12 including a shaft mounted transversely on the carriage adjacent the rearward end of the hood, stub shafts eccentrically carried on the ends of the shaft, rollers on the stub shafts to engage the runway, and means to rotate the shaft to raise and lower the stub shafts with respect to the carriage and thereby elevate the rearward end of the hood relative to the inlet end of the discharge-receiving means to permit translational movement therebetween or seat said rearward end on the inlet end of the discharge-receiving means.

15. Apparatus as defined in claim 1 wherein safety latch means cooperates with said collector hood for holding engagement therewith in the event of a failure of said first-mentioned means.

16. Apparatus for handling a hot contaminant-laden fluid effluent from the mouth of a generator such as a converter and for conducting the effluent into an inlet portion of a cleaning device which comprises, a collector hood defining a longitudinally-extending effluent-flow passageway therealong, said hood having an inlet portion at a lower end of the passageway and an outlet portion at an upper end of the passageway, means for holding said hood in an operative position wherein its inlet portion is in a cooperative effluent-receiving relationship with the mouth of the generator and its outlet portion is in an aligned and sealed-off discharge relationship with respect to the inlet portion of the cleaning device, said means having operative portions to raise said hood out of the above-defined operative position into an inoperative position with respect to the mouth of the generator and the inlet portion of the cleaning device, said means having a bracket pivotally carried with the hood, means carried by the bracket to normally urge it to pivot downwardly, a cable operatively connected to said bracket to maintain it in a raised position and effect the defined movement of said hood, a rack means positioned adjacent said hood, and a pawl operatively mounted to pivot on said bracket and engage said rack upon a failure of said cable.

17. Apparatus for handling a hot contaminant-laden fluid effluent from the mouth of a generator such as a converter and for conducting the effluent into an inlet portion of a cleaning device which comprises, a collector hood defining a longitudinally-extending effluent-flow passageway therealong, said hood having an inlet portion at a lower end of the passageway and an outlet portion at an upper end of the passageway, means for holding

said hood in an operative position wherein its inlet portion is positioned in a cooperative effluent-receiving relationship with the mouth of the generator and its outlet portion is in an aligned and sealed-off discharge relationship with respect to the inlet portion of the cleaning device, said means having operative portions to raise said hood out of the above-defined operative position into an inoperative position with respect to the mouth of the generator and the inlet portion of the cleaning device, said means having a shaft mounted adjacent said hood, a bracket carried by said shaft, a sheave journaled on said bracket to normally urge said bracket to pivot downwardly, a stop to limit upward movement of said bracket, a cable trained about said sheave to maintain said bracket in a raised position against said stop and effect the aligned movement of said hood, a fixed rack extending along the hood and a pawl fixed to the sheave to pivot with said bracket and engage said rack upon failure of said cable.

18. In apparatus for receiving and directing fluid from a mouth portion of a generator vessel, an exhaust receiver having an inlet portion, a hood, a guideway for the hood; said hood having an inlet portion to cooperate with the mouth portion of the vessel, an outlet portion to cooperate with the inlet portion of said exhaust receiver, and a fluid passageway therebetween; and means to move said hood along said guideway and its said inlet portion into and out of a fluid-receiving position with the mouth portion of the vessel and simultaneously move its said outlet portion into and out of a fluid-discharging position with the inlet portion of said exhaust receiver.

19. Apparatus as defined in claim 18 wherein, the inlet portion of said exhaust receiver and the outlet portion of said hood have cooperating sealing flanges, and said sealing flanges are positioned to provide a slide contact with each other when said hood is moved by said means.

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Disclaimer

2,847,206.—*Harry L. McFeaters*, New Castle, Pa. EXHAUST APPARATUS. Patent dated Aug. 12, 1958. Disclaimer filed June 9, 1965, by the assignee, *Pennsylvania Engineering Corporation.*

Hereby enters this disclaimer to claims 1, 2, 8, 12, 18, and 19 of said patent.

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