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(54) Method of applying a mortar material to a surface.

(57) Simulated stone products are prepared by spraying a mortar material, in a blast of compressed air, into a mould by means of a gun 10, 14, 16, to which the mortar material is fed via a lateral inlet 12 by a peristaltic pump. Compressed air is supplied to an axially extending pipe 18 within the body 10 of the gun, the pipe 18 terminating, within the body 10, just short of a nozzle 16 from which the mortar spray is ejected. The mortar is effectively "atomised" in the spray, so that individual aggregate particles, such as sand grains, coated with cement, are hurled at high speed, in the spray, against the mould surface or against the previously deposited particle to form a densely packed aggregate layer which, in curing, de-moulding and surface etching or abrasion, closely simulates the appearance of natural stone. The apparatus and method disclosed allow, inter alia, products which are relatively thin and light, and are yet strong, to be produced economically.

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Method of applying a mortar material to a surface

THE PRESENT INVENTION relates to a method of applying a mortar material to a surface, for example for purposes of masonry repair or restoration, or to a mould surface in the fabrication of a product simulating natural stone.

It is known to produce cement or concrete products, for example in the form of building blocks or slabs, which simulate the appearance of natural stone, such as sandstone, by forcibly compacting a moist mixture of cement and finely divided aggregate, such as sand, into a mould, to cover the mould surface in a layer to which is generally applied a body of ordinary concrete mix as a backing material. On setting of the compacted mixture the concrete provides the bulk of the product and affords a support for the moulded surface, defined by the compacted layer, once the product has been extracted from the mould. The surface of the product exposed to view in the finished building or the like is the surface of the compacted layer which was in direct contact with the mould surface. The close packing of the sand or other aggregate in the compacted layer reduces the size of the interstices between aggregate particles as compared with a conventional mortar or concrete, for example, so that the product has an appearance somewhat similar to natural sandstone, for example.

However the known method referred to is cumbersome, can only be applied effectively to certain basic shapes of product and is not well adapted to volume production. In addition the simulated stone facing material tends to be soft and easy to damage at edges and corners.

It is an object of the invention, in one aspect, to provide an improved method of applying a mortar material to a surface, by which,inter alia, the above disadvantages of the known method of fabricating simulated stone products may be avoided.

According to one aspect of the invention there is provided a method of applying a mortar material to a surface comprising spraying material in finely divided form onto said surface to adhere thereto.

The term "mortar material" as used herein is intended to refer to a mixture of water, cement and an aggregate, generally of a particle size corresponding with that of sand or shingle, although some larger particles may be incorporated in the mix. The term "mortar material" used herein is not intended to imply that the material must be suitable for use as mortar between building bricks, for example and, indeed, the preferred consistency of the mortar material in carrying out the present invention is somewhat stiffer than would be considered ideal for brick-laying purposes.

According to another aspect of the invention, there is provided apparatus for applying a mortar material to a surface, comprising a gun comprising a chamber with an inlet to receive a mortar material into said chamber, pumping means for supplying mortar material to said chamber via said inlet, a nozzle providing an outlet from said chamber and a compressed gas pipe extending within said chamber from an inlet for compressed gas, and having an outlet within said chamber, in the region of said nozzle and directed towards said nozzle outlet, whereby mortar material from said chamber can flow past said pipe towards said nozzle outlet to be entrained by gas flowing at high speed from said conduit outlet towards and through said nozzle outlet, thereby to atomise the mortar material and propel it at high speed, in the form of a spray, from the nozzle.

In preferred embodiments of the invention, items such as architectural cladding panels or stonework, fireplace surrounds or flagstones, of simulated natural stone such as limestone or sandstone are fabricated by spraying the mortar mixture into a mould to form the required product. The product may in certain cases be reinforced by placing a reinforcing structure, such as a reinforcing framework of wire mesh and/or steel rod or wire, in the mould after spraying a first layer of the mixture over the mould surface and before spraying a subsequent layer or layers of the mixture into the mould over and around the reinforcing structure, to unite with the layer first applied. Alternatively, or in addition, a fibrous reinforcement may be incorporated in the mixture before or during spraying. Again the product may be built up in the mould by alternately spraying layers of the mixture and applying reinforcement, until the desired thickness is built up. When sufficient of the mixture has been sprayed into the mould, the mixture is caused or allowed to set, after which the moulded product is removed from the mould. The surface of the product which is to be exposed to view may then treated, for example by sand-blasting or chemically, to remove the cement laitance at the immediate surface and expose the natural colour and texture of the aggregate and give the desired stone-like finish.

Due to the inherent strength of the resulting material, products made in accordance with the invention, whilst reproducing the appearance of the desired natural stone, can be made lighter and stronger than corresponding components of natural stone or corresponding known simulated stone products and can withstand substantial natural loads. Furthermore, simulated stone products can be

made, by methods embodying the invention, in more complicated shapes than is possible using conventional methods.

An embodiment of the invention is described below, by way of example, with reference to the accompanying drawings, in which:-

FIGURE 1 is a side elevation view of a spray gun forming part of an apparatus embodying the invention,

FIGURE 2 is a partial view, in axial section, of the spray gun of Figure 1;

FIGURE 3 is a plan view of a further part of an apparatus embodying the invention;

FIGURE 4 is a side view of the part of the apparatus shown in Figure 3, viewed in the direction of the arrow IV in Figure 3,

FIGURE 5 is an end view of the part of the apparatus shown in Figure 3 and 4, looking in the direction of the arrow V in Figure 3,

FIGURE 6 is a diagrammatic view presenting a vertical section on the line VI-VI in Figure 3, and

FIGURE 7 is a side view of a rotary paddle incorporated in the apparatus of Figures 3 to 6.

In the apparatus described below by reference to the drawings, a mortar material (as herein defined) is pumped to a spray gun which is also supplied with compressed air to discharge, in a blast of air, the mortar material in a finely dispersed or "atomised" spray towards a surface to which the mortar material is to be applied, for example a mould surface or a surface of a piece of masonry which is to be repaired or restored.

Referring to Figures 1 and 2, the spray gun comprises a hollow cylindrical metal body 10 to which is connected, intermediate the ends of body 10, a mortar inlet pipe 12 whereby mortar can pass, via the pipe 12, into the interior of the body 10. To one end of the body 10 and coaxial therewith is secured a hollow frusto-conical nozzle 14 which, at its forward end, remote from the body 10, carries a replaceable nipple 16 affording the spray outlet of the gun. Due to the abrasive nature of the mortar material, and the velocity imparted thereto by the air-blast, the interior of the nipple 16, in particular is subjected, in use of the apparatus, to a "sand-blasting" effect which produces a fairly high rate of wear in the nipple. The nipple is screw-threadedly fitted in a screw-threaded bore at the forward end of nozzle 14 so that the nipple 16 can readily be unscrewed when worn and replaced by a new nipple. Equally, of course, differently dimensioned nipples might be used for different mortar compositions or for different working conditions, for example.

To facilitate cleaning of the spray-gun internally, for example to remove traces of mortar material at the end of a work session before such mortar sets within the body 10, the nozzle 14 is itself detachably secured to the body 10, for example, as shown in Figure 2, by inter-engaging screw-threads on the nozzle 14 and body 10, so that the nozzle 14 can simply be unscrewed from the body 10. To assist in screwing and unscrewing the nozzle 14 the latter is equipped with outwardly projecting wings 15. Extending coaxially within the body 10 is a rigid pipe 18, for compressed gas (normally compressed air), the pipe 18 extending from a plug 20 at the rear end of the body 10 and secured at its rear end in this plug 20. The pipe 18 extends forwardly, through the interior of the body 10 into the interior of the conical nozzle 14 and terminates in a free end spaced just rearwardly of the nipple 16 and directed towards the nozzle outlet afforded by the latter so that there is defined between the conical interior surface of the nozzle 14 and the pipe 18 an annular space which becomes progressively narrower radially towards the nozzle outlet. The air pipe 18 is connected, via the plug 20 and a manually operable air valve 26 with a compressed air line 25 extending from a compressor or other source of compressed air, the compressed air line being connected with the valve 26 via a quick release coupling.

The mortar inlet point 12 is connected, via a flexible delivery hose 28, with the outlet of a pump 30 driven by a motor 32. The inlet of the pump 30 is connected, via a hose 34, with an outlet opening at the lower end of a storage hopper 36 for the mortar material. The pump 30 is preferably a peristaltic pump in which a flexible hose connected with the inlet and outlet of the pump, is pinched by rollers at positions which move along the path along which the flexible pipe is extended, during operation of the pump, to propel the mortar material through the pump. It has been found that a pump of this type is able to pump a stiff mortar mix reliably over long periods and is easily maintained.

As best shown in Figure 6, the lowermost part of the hopper 36 is in the form of a well or channel having the form of part of a cylinder with a horizontal axis and an agitator paddle 37 is rotated about said horizontal axis, in the bottom of the hopper 36, the vanes 39 of the paddle cooperating closely with the said well or channel to minimise the chance of mortar lodging and setting in "dead spaces". The outlet connected with the hose 34 is disposed in the part-cylindrical well or channel.

Disposed directly above the hopper 36 is a mortar mixer 41 which has a lowermost part which is in the form of part of a cylinder with a horizontal axis. The mixture 41 has an upper part defined by side walls 43 extending tangentially upwardly relative to the cylindrical surface of the lower part and terminating in edges of an upwardly open mouth through which the components of the mortar material may be introduced into the mixer. Both the

mixer 41 and the hopper 36 have the cross-sectional shape shown in Figure 6 throughout their lengths and have flat vertical end walls as shown in Figure 4. A further paddle arrangement 45 is also disposed in the mixer and is rotatable about a horizontal axis which is also the axis of curvature of the cylindrical part of the bottom of the mixer 41, the vanes 46 of the paddle 45 being so dimensioned as to cooperate closely with the inner surface of the part-cylindrical portion of the mixer 41. The hopper and mixer paddles 37, 45 have respective horizontal shafts which are journalled in the end walls of the hopper and mixer and extend through said end walls at one end of the apparatus to respective drive pulleys connected by a driving belt, for example a V-belt, or to respective drive sprockets connected by a roller chain. In the arrangement shown, the opposite end of the shaft of paddle 37 carries, outside the hopper 36, a further pulley which is driven, by way of a V-belt by a driving motor 50.

Figure 7 illustrates in more detail the construction of the paddle arrangement 45 for the mixer. (Apart from dimensions, the paddle arrangement 32 for the hopper 36 is similar). As illustrated, the arrangement comprises four arms 45a extending radially from the shaft at intervals therealong, and each carrying a respective vane 46. The vanes 46 are generally flat, each extending in a plane inclined with respect to the rotary axis of the paddle so that the vane is, in effect, a part of a respective helix about the paddle axis. The vanes 46 have arcuate outer edges to cooperate closely with the cylindrical portion of the mixer 41. The pair of vanes nearer one end of the shaft are oppositely inclined to the pair nearer the other end of the shaft (i.e. are of opposite "hand"), so that in operation, as the paddle rotates, each of the paddles tends to displace the mortar material towards the middle of the mixer. Each vane 46 is of composite construction comprising a backing plate 46a welded to the respective arm 45a and a sheet 46b of flexible belting material sandwiched between the backing plate 46a and a clamping plate 46c bolted to the plate 46a through the sheet 46b. The sheet 46b, like the plates 46a and 46c, has an arcuate outer edge but this edge of sheet 46b projects outwardly beyond the plate 46a and 46c slightly for actual rubbing contact with the inner surface of the cylindrical part of the mixer 41. As noted above, the construction of the paddle 37 for the hopper 36 is similar, including the vane construction, and the belting sheets of the vanes 39 likewise make rubbing contact with the cylindrical inner surface of hopper 36. For ease of illustration, the vanes 46 are omitted in Figure 3.

An opening is provided in the lowermost part of the mixer 41 and is closed by a hinged door 49 which can be opened when mixing of a batch of the mortar material has been completed, to allow the mixed batch to fall into the hopper 36.

As noted above, the use of the term "mortar material" herein is not intended to imply that the material must be suitable for use as mortar between building bricks, for example and, indeed, the preferred consistency of the mortar material in carrying out the present invention is somewhat stiffer than would be considered ideal for brick-laying purposes. The air compressor or other source of compressed air connected with the air pipe 18 is capable of maintaining a pressure of several atmospheres in the compressed air hose 25 with the valve 26 open and the gun in operation, so that a jet of air of substantial force and velocity emerges from the forward end of the pipe 18 to pass through the nipple 16. The operation of the pump 30 ensures a steady flow of mortar material into the annular space within the body 10 around the pipe 18 so that there is a steady flow of mortar material through the frusto-conically narrowing annular space within the nozzle so that fresh mortar material is continuously flowing into the region of the air jet emerging from the pipe 18 to pass through the nipple 16 whereby such mortar material can be entrained by the jet and discharged, through the nipple 16, in a fine spray in which, by and large, the individual aggregate particles, each with a cement/water coating, are physically separate from the other such particles in the spray and travel with high velocity towards the surface to which the spray is directed impacting with the said surface with considerable force. As a result of this force, in the layer of mortar material deposited by the spray on the surface to which the spray is directed, the individual aggregate particles are closely packed, as if they had been compacted in the natural process of forming sandstone, for example, with the spaces between aggregate particles occupied by the cement/water mixture being of minimal size. As a consequence of this close packing, after the removal of any cement layer which may form on the exposed surface of the product, or (in the case of a moulded article) on the surface of the product directly contacting the mould surface, the surface of the material is provided to a great extent by the surfaces of the aggregate particles themselves and has far fewer and smaller pores than would be the case with a conventional mortar so that the product has more the appearance of a natural stone than of a product moulded or formed from concrete or cement.

The apparatus described allows the mortar material to be deposited, in densely compacted condition on substantially any stable surface in a layer of desired thickness, for example in a layer as thin as 1/16" (1.5mm) in thickness and in any orienta-

tion, for example to a vertical surface or to a downwardly facing horizontal surface (i.e. inverted working).

Accordingly, as well as allowing the manufacture of conventional products in conventional moulds, novel products in simulated stone or concrete can be readily manufactured by spraying the mortar material around the interiors of relatively complex moulds or in a layer of desired thickness over the exterior of a former. Thus, it is possible, for example to form relatively thin sheets of simulated stone. The resulting products are strong so that whilst, as noted above, reinforcement may be utilised, such reinforcement is in many cases unnecessary.

As there is a tendency for a film of cement-laitance to form between the mould surface and the adjoining aggregate particles, which forms, in the cured, de-moulded product a surface coating of cement which obscures the underlying aggregate from view, it is generally preferred to treat the surface of the product to remove this surface coating of cement, for example by sand-blasting the surface of the product or by a chemical etching or the like step, thereby to expose the colour and texture of the aggregate and give the desired stone-like finish.

Whilst the aggregate employed would generally be a natural aggregate such as sand or shingle, it will be appreciated that aggregates which are not naturally occurring, for example finely divided ceramic particles or the like, for example pigmented materials, may be utilised to afford any desired effect.

The features disclosed in the foregoing description, in the following claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A method of applying a mortar material to a surface comprising spraying material in finely divided form onto said surface to adhere thereto.

2. A method of fabricating a product simulating natural stone, comprising spraying a mortar material comprising a mixture of cement and an aggregate into a mould, allowing or causing the mixture to set and de-moulding the product from the mould.

3. A method according to claim 2 wherein, after de-moulding the product the surface thereof is treated to expose the aggregate and give a stone-like finish.

4. A method according to claim 2 or 3 wherein a reinforcing structure or material is placed in the mould before, during or after spraying of the mixture into the mould but before the mixture has set.

5. A method according to claim 4 comprising spraying a first layer of said mixture into the mould, positioning said reinforcing structure or material in the mould and spraying a second layer of said mixture into the mould, over said reinforcing structure or material.

6. A method according to any of claims 1 to 5 wherein said spraying is effected by introducing the mortar material into a jet of gas issuing at high speed under pressure from a conduit for such gas.

7. Apparatus for applying a mortar material to a surface, comprising a gun comprising a chamber with an inlet to receive a mortar material into said chamber, pumping means for supplying mortar material to said chamber via said inlet, a nozzle providing an outlet from said chamber and a compressed gas pipe extending within said chamber from an inlet for compressed gas, and having an outlet within said chamber, in the region of said nozzle and directed towards said nozzle outlet, whereby mortar material from said chamber can flow past said pipe towards said nozzle outlet to be entrained by gas flowing at high speed from said conduit outlet towards and through said nozzle outlet, thereby to atomise the mortar material and propel it at high speed, in the form of a spray, from the nozzle.

8. Apparatus according to claim 7 wherein said nozzle has an interior surface tapering conically towards said nozzle outlet and said gas pipe includes a terminal portion which is located within the region, within the nozzle, bounded by said conically tapering surface, is co-axial therewith and terminates in said conduit outlet facing towards said nozzle outlet.

9. Apparatus according to claim 6 or claim 7 wherein said pumping means comprises a peristaltic pump.

Fig.1.

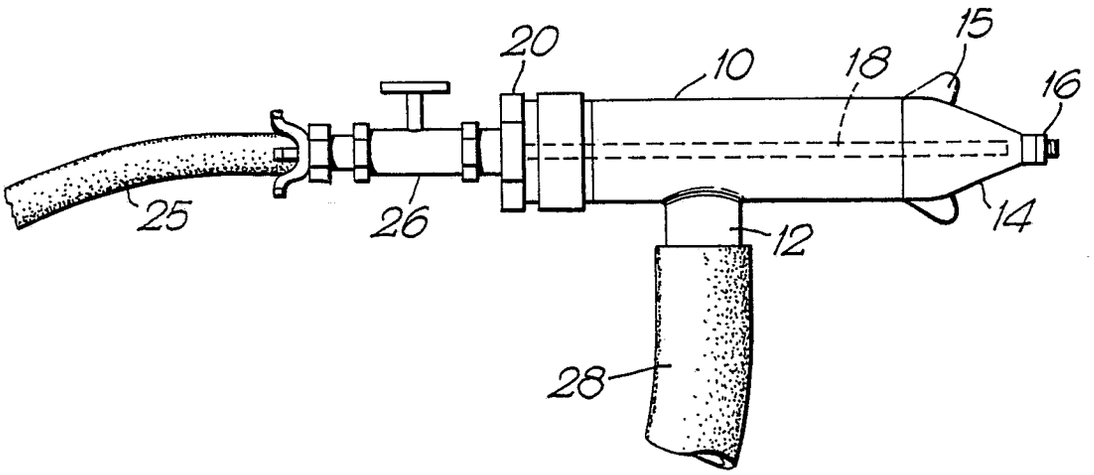


Fig.2.

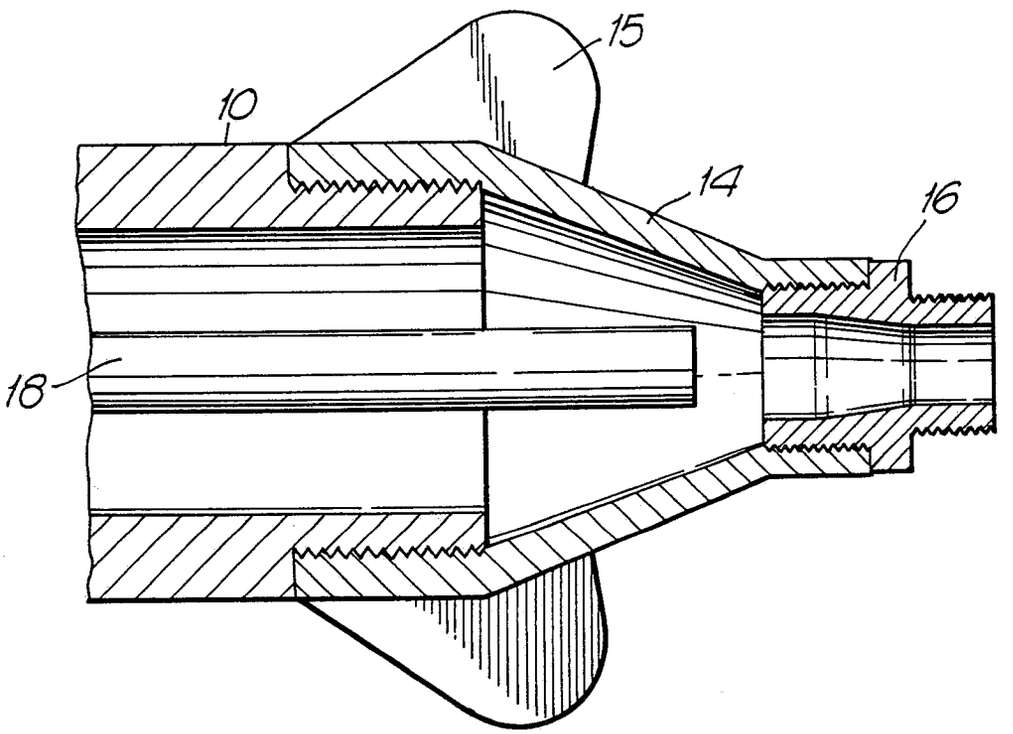
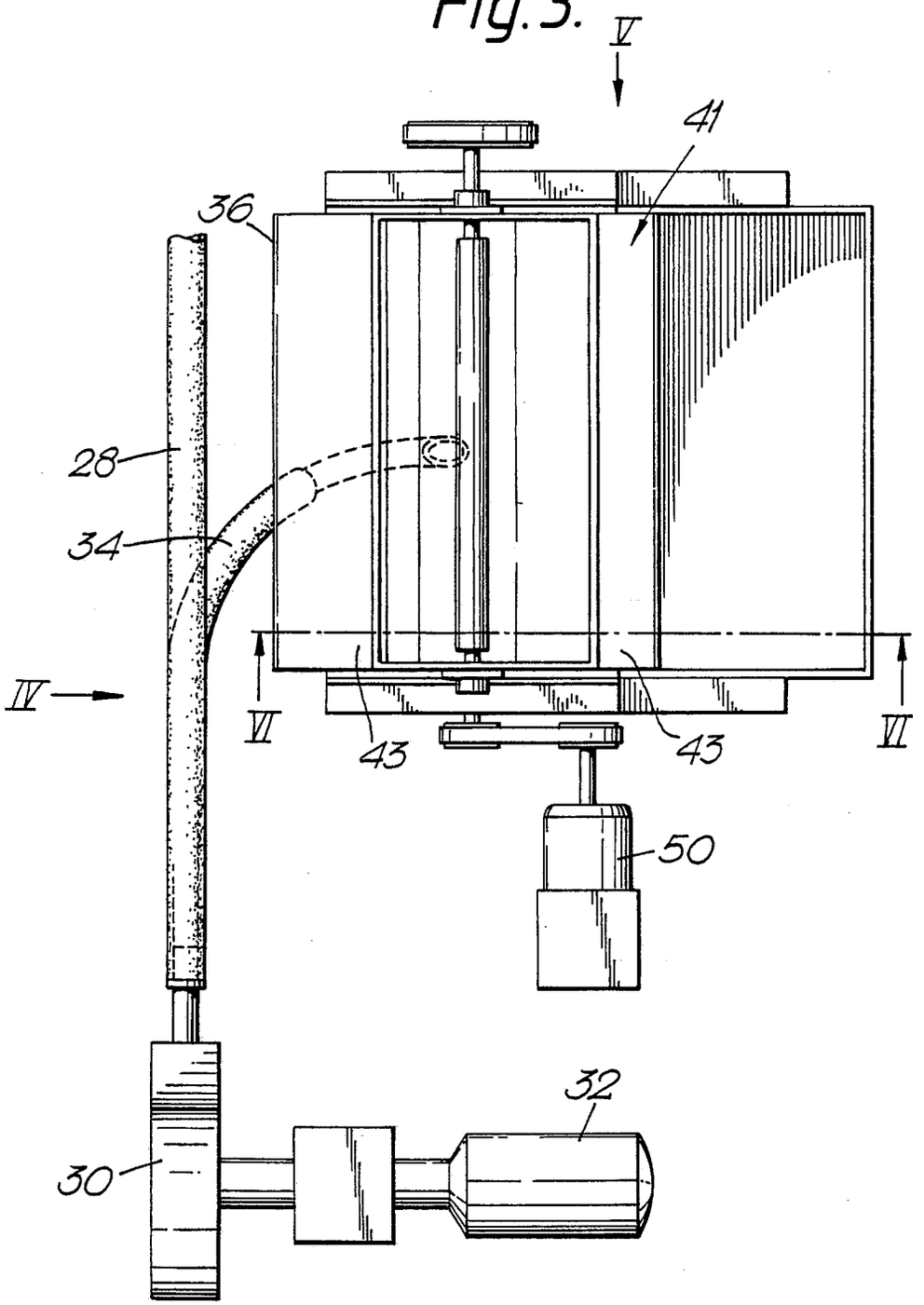


Fig. 3.



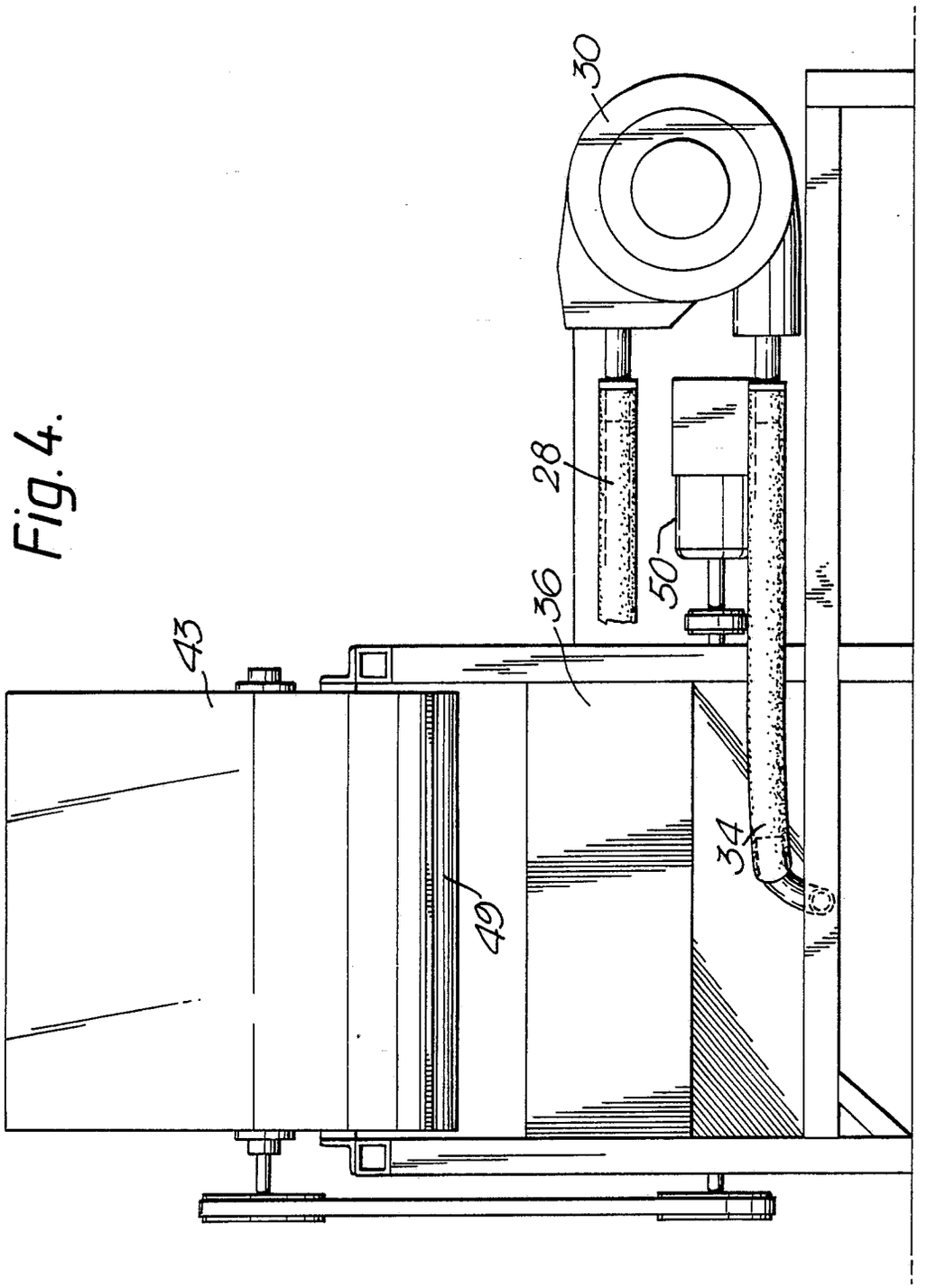


Fig. 4.

Fig.5.

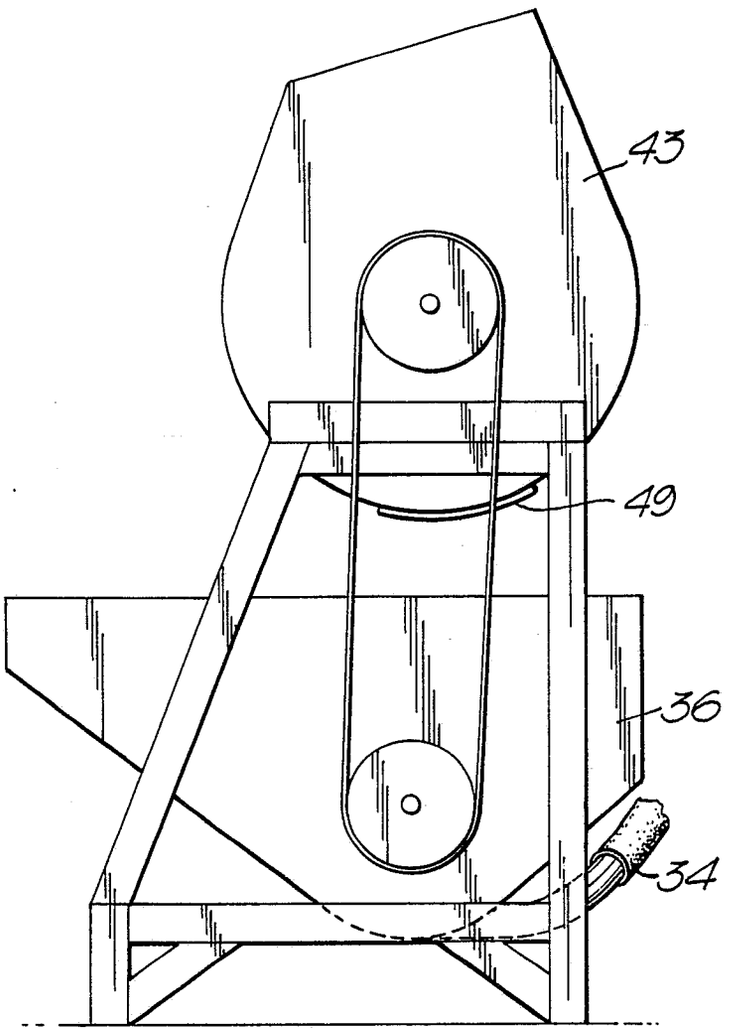


Fig.6.

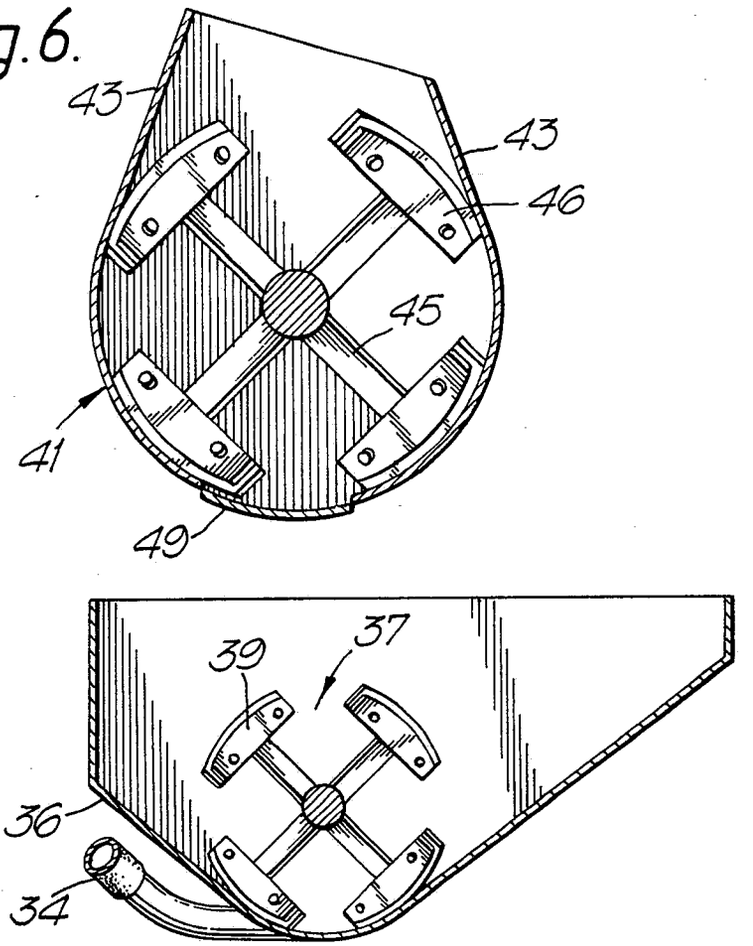

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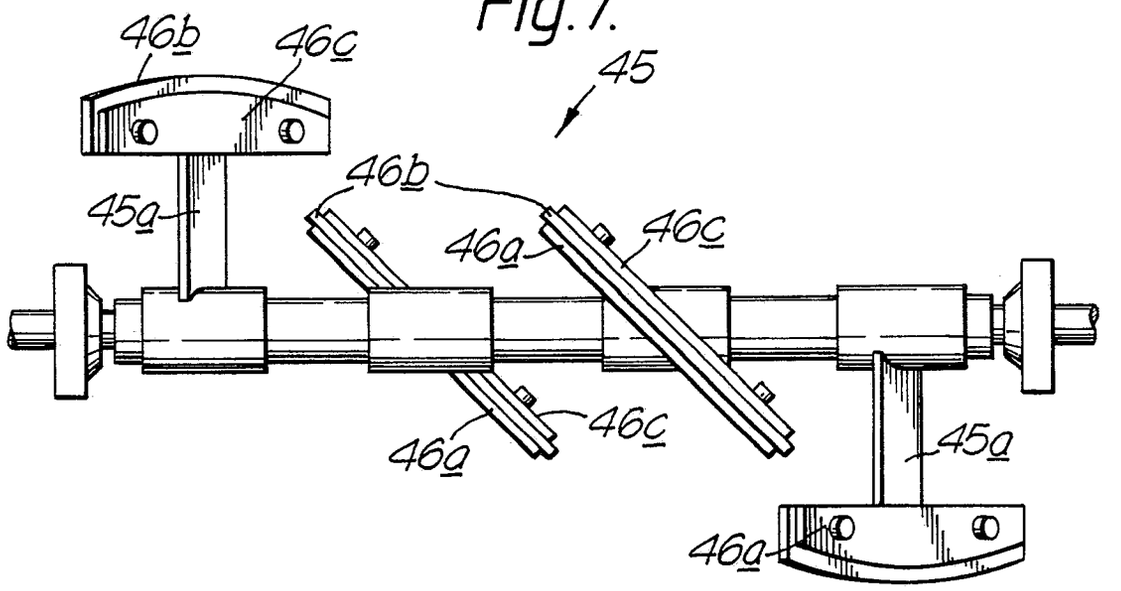
Fig.7.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