for a powder delivery device that achieves these objectives, yet is simple and inexpensive to manufacture and to use.

There has now been devised an improved form of powder delivery device that addresses these needs and/or overcomes or substantially mitigates disadvantages associated with the prior art.

Thus, according to an embodiment ~~first aspect of the invention~~, there is provided a device for the dispensing of a powder,

the device comprising, or being adapted to be coupled to, a powder receptacle and a gasflow generator adapted, in use, to cause gas to flow through the device,

and the device further comprising an agitator by which the powder and/or the powder receptacle can be mechanically agitated,

the gasflow generator and the agitator being operably linked such that actuation of the gasflow generator, which causes gas to flow through the device and to entrain powder from the powder receptacle, thereby to dispense powder from the device, is accompanied by actuation of the agitator, causing the powder receptacle to be mechanically agitated, thereby facilitating the release of powder from the powder receptacle.

In the device according to an embodiment~~the invention~~, actuation of the gasflow generator, which results in dispensing of powder from the device, is accompanied by mechanical agitation of the powder receptacle. Such agitation facilitates the release of powder from the powder receptacle, and may also give a more uniform distribution of powder material dispensed from the device.

The powder receptacle may be an integral part of the device according to an embodiment~~the invention~~, such that the device is supplied with a quantity of powder contained within the powder receptacle. In such a case, the device may be a disposable device, which is discarded after the desired quantity of powder has been dispensed from the powder receptacle.

Alternatively, the powder receptacle may be a separate component that is coupled to the device prior to use. In such a case, the powder receptacle, containing a quantity of powder, is typically supplied with a closure that is removed to enable the receptacle to be coupled to the device. The device and the receptacle may be formed with cooperating formations that enable them to be coupled together. For example, the device may be formed with an upstand or spigot that is received within or about a neck of the powder receptacle.

In currently preferred embodiments, the powder receptacle is supplied in the form of a sealed vial, eg of glass, that contains a quantity of powder. The vial has a neck that is sealed by a removable closure. When the closure is removed, a device according to ~~the invention~~an embodiment is engaged with the vial, by insertion into the neck of the vial of a tubular spigot that has an interference fit with the interior of the neck. When the vial, which is coupled to the device, is then inverted, powder in the vial falls into the spigot. In such an arrangement, loss of powder from the spigot is preferably inhibited or prevented by a perforated base member that extends across the interior of the spigot. Other embodiments of powder receptacle that may be used include cartridges, eg of plastics materials. Such receptacles may be supplied with closures that are removed prior to attachment of the cartridge to the device, or the device and the powder receptacle may be configured such that engagement of the powder receptacle with the device brings about opening of the powder receptacle. For instance, the powder receptacle may comprise a foil closure that is ruptured by appropriate formations on the device when the receptacle is engaged with the device.

The perforated base member retains the bulk of the powder within the powder receptacle prior to actuation of the gasflow generator, but permits powder to pass through the base member when the powder is entrained in the gasflow generated by actuation of the gasflow generator. The nature of the base member should therefore be such that the perforations in the base member are small enough that, when the powder rests upon the base member, its packing characteristics and

angle of repose are such that the powder does not pass to any significant extent through the base member. On the other hand, the perforations should be such that, when the powder resting upon the base member is energised and entrained in the gasflow, it is able to pass through the perforations in the base member and be dispensed.

Conveniently, the base member takes the form of a perforated plate, which will typically be circular. Preferably, a substantial proportion, or the full extent, of the plate is perforated. The perforations in the base member may have any suitable shape, eg circular, square or hexagonal, and will typically be arranged in a regular array and/or uniformly across a substantial proportion, or even the full extent, of the base member.

Thus, according to another embodiment~~aspect of the invention~~, there is provided a device for the dispensing of a powder,

the device comprising, or being adapted to be coupled to, a powder receptacle,

the device further comprising, or being adapted to be coupled to, a gasflow generator adapted upon actuation to cause gas to flow into the powder receptacle,

wherein the powder receptacle is oriented, in use, such that, prior to actuation of the gasflow generator, powder contained within the receptacle settles under gravity and is retained within the powder receptacle by, and rests upon, a perforated base member.

In such embodiments, the gasflow may enter the powder receptacle through the base member, thereby energising powder resting upon the base member and causing said powder to be entrained in the gasflow and to pass through the base member into an outlet conduit, thereby to dispense said powder from the device. Gas is caused to flow through the perforated base member and this gasflow energises the particles of powder resting upon the base member, in the sense of imparting kinetic energy to those particles and entraining them in the gasflow. In other embodiments, a channel or conduit is provided to conduct the gasflow to a

The gasflow generator may be either an integral part of the device according to ~~the inventionan~~ embodiment, or an external component to which the device is coupled.

Where the gasflow generator is part of the device, it may take various forms. For instance, the gasflow generator may comprise a compressible bulb or bellows that can be manually compressed by the user. In such a case, the bulb or bellows is preferably resilient and may include a one-way valve or an opening that permits the ingress of air to permit the bulb or bellows to return to its expanded condition after pressure applied to it is released. In such embodiments, the gas is generally ambient air.

In other embodiments, the gasflow generator is a canister of a compressed gas or a liquefied propellant. Compressed gases include compressed air, and compressed hydrocarbons. Liquefied propellants include chlorofluorocarbons and hydrofluoroalkanes. In all such embodiments, the canister will generally be provided with a valve by which the gasflow can be controlled.

In yet further embodiments, the gasflow generator does not itself form part of the device according to ~~the inventionan~~ embodiment, but is an external gas source to which the device is coupled. In such embodiments the device may, for instance, be coupled to a compressed gas source by an appropriate conduit, eg a flexible tube. The gas line may be a compressed air line, though other compressed gases may be used, eg nitrogen or carbon dioxide. Again, the arrangement will generally include means by which the gasflow can be controlled. Typically, the device will include an actuator, eg of the push button type, by which the flow of gas can be controlled.

In the device according to ~~an embodiment~~~~the invention~~, actuation of the gasflow generator is effectively synchronised with actuation of the agitator. The arrangement may be such that actuation of the gasflow generator causes actuation of the agitator, or vice versa.

In certain embodiments ~~of the invention~~, the agitator may be operably linked to the actuator by which the gasflow is controlled. For instance, the actuator may be coupled to a trigger mechanism that causes a striking element to impact upon the powder receptacle.

In other embodiments, the agitator may be driven by the gasflow, such that the agitator operates for as long as the gas flows and is disengaged when the flow of gas is halted. In presently preferred embodiments, the agitator includes a moveable element that is positioned within the gasflow path. Such a moveable element is preferably mounted such that its movement generates mechanical disturbances or vibrations within the device, leading to physical agitation of the powder contained within the powder receptacle. In particularly preferred embodiments, the path along which gas is caused to flow includes a loop within which an agitator element is driven. Conveniently, such a loop has the form of a circular track and the agitator element is a ball or the like that is driven around the track by the gas flow. The movement of the ball generates vibratory forces that are transmitted through the device to the powder receptacle. In other embodiments, agitation of the powder receptacle may be brought about by actuation of an electric motor or the like.

Powder is preferably discharged from the device according to ~~the invention~~an embodiment via a discharge tube or barrel. Such a discharge tube or barrel may be capable of a limited degree of orientational movement relative to the rest of the device, in order that the direction of flow of the discharged powder may be adjusted to suit the needs of the situation in which the device is used, eg to facilitate optimal delivery of the powder during a surgical procedure.

The device according to an embodiment~~the invention~~ will most commonly comprise components manufactured wholly or largely of plastics materials. Where appropriate, however, other materials such as metals, eg stainless steel, and glass, eg for the powder receptacle, may be employed. For medical applications, the materials used may be of suitable medical grade and sterilisable.

For ease of use, the components of the device according to an embodimentthe ~~invention~~ may be incorporated into an outer housing that facilitates operation of the device. For instance, the device may be configured such that it can be readily held and operated in one hand.

The device according to an embodiment~~the invention~~ may be used to deliver a wide variety of powders to a surface of the body. Such powders include agents intended to have a therapeutic effect, either in terms of a pharmacological effect on the body or as disinfectants or the like useful in the prevention or treatment of infections. One particular field in which the device of ~~the invention~~an embodiment is useful, however, is for the delivery of haemostatic powder compositions to internal tissues exposed during surgical procedures or after traumatic injury. Such haemostatic compositions, which may also be described as tissue sealants, may for instance comprise dry powder mixtures of fibrinogen and thrombin. Such a mixture is essentially inert when formulated in the dry state, but once hydrated, eg upon application to a bleeding wound, the mixture leads to the production of fibrin which cross-links to form a blood clot.

Thus, according to a further embodiment~~aspect of the invention~~, there is provided a method of delivering a haemostatic composition to an internal tissue exposed during surgical procedures or after traumatic injury, which method comprises providing a device as described above, which device is charged with a quantity of a haemostatic composition in dry powder form, and dispensing said composition from said device onto said tissue.

According to an aspect, there is provided a device for the topical dispensing of a powder, the device comprising, or being adapted, in use, to be coupled to, a powder receptacle and a gasflow generator adapted, in use, to cause gas to flow through the device, and the device further comprising an agitator by which the powder receptacle can be mechanically agitated, the gasflow generator and the agitator being operably linked, in use, such that actuation of the gasflow generator, which causes gas to flow through the device and to entrain powder from the powder receptacle, thereby to dispense powder from the device, is accompanied by actuation of the agitator, causing the powder receptacle to be mechanically agitated, thereby facilitating the

release of powder from the powder receptacle, wherein the agitator is driven by the gasflow, such that the agitator operates for as long as the gas flows and is disengaged when the flow of gas is halted, and the agitator includes a moveable element that is positioned within the gasflow path.

Embodiments of the invention will now be described in greater detail, by way of illustration only, with reference to the accompanying drawings, in which

Figure 1 is a schematic side view of a first embodiment of a powder delivery device according to the invention, partly in section, and showing a trigger mechanism in a rest condition;