To all whom it may concern:

Be it known that I, Edward Cyril Bowden-Smith, of Careys, Brockenhurst, Hampshire, England, engineer, have invented certain new and useful improvements in and relating to Pneumatic Ejectors, of which the following is a specification.

This invention relates to the utilization of pneumatic ejectors of the type employed for raising a liquid or semi-liquid, by means of compressed air.

Briefly, the ejectors in common use for raising sewage consist of spherical vessels, into which the liquid flows by gravitation. When full a weighted float rises on the surface, to this float is attached a rod passing through the crown of the ejector, which actuates certain valves allowing compressed air to exert the necessary force directly on the surface of the liquid, till it has been discharged through the outlet pipe at the base of the ejector, eventually rising through a main to the required level. By this means solid matter is first driven out of the ejector.

When the discharge is completed the weighted float falls, closing the air valve and opening the exhaust, the compressed air escaping to the atmosphere. They are usually worked in pairs, and are arranged in such a manner that although they are entirely automatic they are both alternating or differential in action, as circumstances requires.

The object of this invention is to utilize a part of the exhaust from the ejector and to use it in an air engine to recompress a part of the exhaust to be used in the ejector again.

An ejector made in accordance with this invention is provided with a motor adapted to be operated by the exhaust from the ejector for the purpose of recompressing a portion of the air from the exhaust of the ejector to a pressure at which it can be used again and an arrangement of valves and parts for automatically controlling and operating the mechanism. The motor and the compressor may each have one or more cylinders and these may be single or double acting.

The drawings show apparatus embodying the features of this invention.

Figure 1. is a section showing the general arrangements of parts. Fig. 2. is a similar view at right angles to Fig. 1. Fig. 3. is a sectional plan. Fig. 4. is a diagram showing pneumatic control. Fig. 4" is an enlarged detail of valve 13.

It will be seen that the air motor compressor A consists of two double acting air cylinders c and b on either hand, with the single acting compressor e in the center. They are mounted on a bed plate d, which forms the bottom cover of the two air cylinders, with a similar plate for the top cover, on which are cast the cross head guides. To this top cover are bolted two A frames e which support the crank shaft f and two fly wheels g and h. The motor compressor used in connection with this invention is described in my British specification No. 11,381 of 1913.

For the purpose of explanation, we will now assume that an ejector has finished discharging, the various automatic valves in their correct position and the exhaust air from the ejector flowing through the pipe to the air motor. The exhaust air from the ejector passed into and fills a jacket surrounding the compressor itself. This jacket, by reason of the hot walls of the compressor, will tend to dry and warm the air before it passes to the air motor cylinders. The air performs its work expansively till at the correct moment the exhaust valve from the ejector opens and the exhaust air which is now at a lower temperature, flows through the exhaust pipes to the suction chamber of the compressor. The cubic capacity of the compressor cylinder being small, relatively to that of the motor cylinders, the compressor cylinder will not have sufficient capacity to draw in the whole of the exhaust air from the two motor cylinders, consequently what is not required will escape from an exhaust on the top of the motor to the atmosphere.

We will follow the air in its course from its entrance by the main to its indefinite consumption, or escape to the atmosphere. It must be understood, that in this system, a certain percentage of the air can be used an unlimited number of times, but the air which is not required escapes automatically either by the atmospheric pipe, from the suction chamber of the compressor or by the exhaust valve hereinafter termed the differential exhaust valve. The pressure air for operating the ejectors enters by the inlet pipe f, flowing down the air main k it passes through the dirt box m and discharges into the receiver n after passing the reflux valve o. From this receiver it flows upward by the pipe n' to the alternating valve p then passes to
either of the automatic valves $q$ and down to
the ejectors $r$'s by the pipe $q'$. Having
discharged the liquid from the ejector the
air returns through the same pipe $q'$ to the
automatic valves $q$ and thence to the differen-
tial exhaust valve $s$. This being closed
the air finds a passage down the pipe $n'$
leading to the non-return valve $u$, after pass-
ing this valve the air travels through the pipe $t$ to the motor $\Lambda$, by a connection not
shown, which recompresses a part of the air
and discharges the same into the receiver $u$,
by the pipe $n'$, after passing the non-return
valve $v$, the connection between the com-
pressor and the pipe $n'$ not being shown.
The air that is not required by the com-
pressor escapes from the compressor exhaust
on the engine, up the pipe $w$ to the atmos-
phere.

These valves are operated by compressed
air flowing through small pipes, and for the
purpose of explanation a diagram (not to
table) is given. In Fig. 4 the cross hatch-
ing indicates parts filled with compressed
air. In the ejector not hatched compressed
air is about to discharge liquid from the
ejector. In the diagram the right-hand
ejector has just discharged, and the left-
hand ejector is about to do so. Taking the
left-hand ejector, it can be seen the float $3$
has risen throwing over the slide valve $4$
which has opened the port $5$ allowing the
compressed air from the main supply pipe
11, which is connected to the slide valve
chest to pass up the pipe $6$ and drive over
the automatic valve $q$ closing the exhaust
port $7$ and opening the air port $8$. The air
is able to drive over the automatic valve, as
described since it will be observed that at the
same time the slide valve $4$ opens the port $5$,
it opens the port $9$ to exhaust thus releasing
the pressure from the pipe $9'$. Again this
releasing of pressure allows the alternating
valve $p$ to be driven over by the pressure
from the opposite end, and so opening the
port $10$ allowing direct communication be-
tween the main air inlet $11$ and the connect-
ing mains $12$ and the ejector $r$. This
releasing of pressure allows of the fall of the
intercepting valve $13$ which closes the port
14 the valve being held tightly on its seat
by the pressure in the pipe $15$. It will be
observed that the differential exhaust-valve
$s$ is open allowing communication from the
automatic valve $q$ and exhaust port $7$ which
is closed, to the atmosphere. All these
valves remain in this position while the air
is discharging the liquid in the ejector $r$.
This being completed the float $3$ falls, the
slide valve $4$ closes the port $5$, air pressure
and opening port $5$ to an exhaust, not shown.
The pressure is released on one end of the
automatic valve $q$ and the said valve is driven over from the opposite end by the
pressure passing up the pipe $9'$ from the
port $9$. The air port $8$ is closed and the exhaust port $7$ is opened. Again at the
same time alternating valve $p$, in spite of the
pressure in the pipe $9'$ and $17$ (which it will
be seen is in connection with port $9$) re-
 mains where it is, owing to the pressure at
the opposite end, but the intercepting valve
13 is forced upward by the pressure opening
the port $14$ and allowing the differential
exhaust valve $s$ to be driven over. The air
having already escaped from the opposite
end of $s$ through the port $14$ to the automatic
valve, and thence to the motor by way of
pipe $t$. Again this closes the port $18$, which
compels the exhaust air from the ejector in-
stead of finding its way to the atmosphere
to flow through the valve $u$ and pipe $t$ to
the air motor; assuming that this ejector
which has just discharged fills again before
the other becomes full the alternating valve
$u$ remains where it is; the differential ex-
haust $s$ remains where it is, the automatic
valve $q$ opens the air and closes the exhaust
while the intercepting valve $18$ opens and
closes at the same time as the movement of
the slide valve $4$, but the passage of the air
does not operate the differential exhaust as
the valve is already in its right place and
remains so until the other ejector comes into
action. As long as this ejector alone fills and
empties this action continues. When the
other ejector fills and has discharged the
liquid it closes its own differential ex-
haust and it cannot fail to open the exhaust
for the other, whether there is any exhaust
air remaining to be liberated or not so by
this simple means, we secure a perfect, au-
tomatic, safety attachment, in the event of
failure of the motor. In other words, either
ejector will release the exhaust for its fel-
low and so automatically "cut out" the mo-
tor in the event of failure. In the event of
valve $13$ being closed before the valve $s$
has been driven over, and thereby the exhaust
being prevented from escaping, the air con-
tained in the cylinder $s$ can exhaust through
a port in the casing $14$'. This port is closed
by the stem of the valve $13$ when the valve
is raised, but when the valve is closed the
exhaust can escape from the valve $s$ through
a channel $13''$ in the stem of the valve and
out at the port, the stem of the valve thus
acting as a slide valve to open and close the
port.

The use of the differential exhaust is to
keep the exhaust pipe closed so that the air
will flow to the motor. The object of in-
troducing the intercepting valve, it will be
seen, is to prevent the differential exhaust
from being driven over till the liquid in the
ejector has been discharged. In other words
it intercepts the passage of the air and de-
lays the action of the differential exhaust.

If there were no intercepting valve, the
differential exhaust would drive over at
once at the same time as the alternating valve, and the exhaust from the ejector that had just discharged would at once escape to the atmosphere instead of being stopped and so flowing to the motor. By opening the two by-pass stop valves the ejectors return to the simple conditions of working and are then as independent of the motor and accessory valves as if they did not exist.

It is obvious that by this simple automatic device either ejector can "cut out" the motor and at the same time safeguard their own continuous working.

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

1. In pneumatic ejectors the combination of a motor adapted to be operated by the exhaust from the ejector; an air compressor for the purpose of recompressing a portion of the used air; a differential valve for opening and closing the exhaust ports and means for conducting the exhaust air to the motor and compressor.

2. In pneumatic ejectors the combination of a motor adapted to be operated by the exhaust from the ejector; an air compressor for the purpose of recompressing a portion of the used air; a differential valve for opening and closing the exhaust ports and an intercepting valve for delaying the return of the differential valve and allowing one ejector to be discharged while the other is exhausting to the air motor.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

EDWARD CYRIL BOWDEN-SMITH.

Witnesses:

LOUIS BELROSE,
FRANK B. RAIBDEN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."