To all whom it may concern:

Be it known that I, FRED BROTHERHOOD, of Charleston, in the State of South Carolina, have invented an Improvement in the Method of Excavating and in Apparatus Therefor, of which the following is a specification.

My invention relates to an improved method and apparatus for removing or excavating phosphate rock and analogous materials, such as the various mineral or metallic substances which are found in more or less extensive and compact bodies covered or surrounded by mud, sand, gravel, or other substances readily separable from the material to be excavated.

Therefore, in the employment of machines for securing phosphate rock in the usual way, the rock and the overlying and surrounding or intermixed mud, &c., have been excavated and elevated together. In this manner not only is there required considerable labor and power in excavating and elevating refuse matters, but the working capacity of the apparatus is reduced in proportion to the amount of refuse material which is handled unnecessarily.

Now, in accordance with my invention, I remove the refuse, or the greater part thereof, from the material to be secured before excavating and elevating it, and I do this by directing forcible jets of water, steam, or air against and over the material to be secured, thereby washing away or blowing off the refuse.

My invention may be beneficially adapted to use in working mines or excavating on land as well as in excavating under water; but as it is in this instance applied in connection with a dredging-machine for securing phosphate rock, such application needs only to be described in order that those skilled in the art may understand not only this particular application but the various other analogous uses to which my improvements, or the main feature thereof, may be applied.

In the accompanying drawings, Figure 1 is a side elevation, showing with sufficient fullness for the purpose of this description a dredging-machine with my improvements. Figure 2 is a plan view. Figure 3 is a view partly in rear elevation and partly in vertical section on the line 3 3 of Fig. 2. Figure 4 is a plan or top view, showing on an enlarged scale the lower end of the bucket-ladder, with self-adjusting jet-nozzles at the outer sides thereof; Figure 5, a view partly in end elevation and partly in section on the line 5 5 of Fig. 4. Figure 6 is a view partly in side elevation and partly in section, showing a jet-nozzle at the inner side of the bucket-ladder. Figure 7 is a plan view of one of the dredge-buckets.

The dredge-vessel A is of any suitable and well-known construction, and is provided with all the needed appliances, including the endless chain of buckets B; the hinged bucket-ladder or vertically adjustable frame C, swinging about its pivotal support at A, and supported and raised and lowered at its opposite end by means of chains D D, passing over suitable pulleys and connected with winches E E; the bow and stern windlasses F F F; an engine G; gearing connected with the engine for driving the chain of buckets; and inclined chutes, H H, into which the dredged material is emptied in succession by the buckets to be delivered into scoops at the sides of the dredge-vessel.

So far as described by reference to the above enumerated parts there is nothing new in the apparatus, and the operation of those parts and all other features of the fully-organized 80 dredging apparatus are well understood.

In connection with the above-described endless chain of buckets or equivalent excavating and elevating devices, I provide means by which to deliver a jet or jets of water, or if it may be air or steam, if preferred, forcibly against and over the material which is to be secured, so that all readily removables substances—such as mud, slime, sand, &c.—will be washed or blown away, thus exposing the rock and leaving it comparatively clean to be broken up and lifted by the buckets.

By preference there are two jet-nozzles, I I, one at either side of the bucket-ladder, and the jets are directed against and over the surface of the rock which is about to be acted upon by the buckets. The nozzles connect with supply-pipes J J, leading to pumps K K. In order that the nozzles will always be maintained at proper inclination to direct the jets suitably, they are preferably supported, by self-adjusting pendulums or weights pivot.
pendent brackets L, L. These brackets, by
their gravity, will always hang vertically, or
nearly so, from their shaft or pivot 1, thus
properly directing the jets from the nozzles re-
gardless of variations in the inclination of the
bucket-ladder arising from the differences in
the depth at which the rock is operated upon.
The nozzles connect, by flexible sections j j of
tubing, with the pipes J J, which are by pref-
erence of metal.

In lieu of the pendulum weight or brackets
L, L, other self-adjusting supports for the noz-
25 zles may be employed—such, for instance, as
shown in Fig. 1, where the pivoted ball M of
the raising and lowering devices of the bucket-
ladder is pivotally connected by a link-rod, m,
with a crank arm or lever, n, and to the shaft
or journal N of this lever, corresponding with
the shaft I of the brackets L, the nozzles are
connected, so as to partake of the rocking
movements imparted to the shaft in an obvious
way by its connection with the bail M.

The pipes J J are joined with the pumps K
by suitable flexible connections, to permit of
25 the inclination of the bucket-ladder being va-
ried, and the pumps are operated in well-
known way.

In order to reduce to the minimum the
amount of sand, mud, and water delivered into
the chutes along with the rock, each of the
buckets is made with one or more holes in its bottom. A bucket with a number of small
holes in its bottom is shown in Fig. 7. In
this way the water brought up by each bucket
runs out and is directed into the following
bucket, thereby materially assisting in washing
out any sand or mud which may be with the
rock.

From the above description it will readily
be understood that by my method of excavat-
ing and elevating phosphate rock I avoid a
vast amount of labor which would ordinarily
be required in washing the rock, either afloat or
ashore, besides increasing the amount of work
accomplished in a given time by the appar-
uatus employed.

It is obvious that the pumps for supplying
the nozzles need not be of any particular con-
struction, and that they may be located and
operated as most convenient. It is further
obvious that the nozzles may be forked, as rep-
sented in Fig. 4, where one branch of each
nozzle is shown by dotted lines, and is curved
inward, so as to direct the jet against and over
the rock in front of the buckets. In some
cases the inwardly-directed jets only would be
needed, and then the nozzle branches shown
in full lines would be dispensed with, and
these shown by dotted lines used alone; but
the outwardly-directed nozzles only are best
adapted for use in connection with the dred-
ing apparatus shown, the bow of the vessel A
being swung sidewise, first one way and then
the other, and the rock thus cleaned off in ad-
vance of the action of the buckets. In this
way there may be saved small bits of rock
broken up by the buckets, some of which
would be washed away were the jets to im-
pinge upon the rock directly in front of the
buckets.

I claim as my own invention—
1. The herebefore-described method of
excavating and elevating phosphate rock or
analogous material freed or nearly so from
mud, sand, or other readily-separable sub-
stances, which consists in washing or blowing
away the overlying and surrounding sub-
stances, and then excavating and elevating
the material, substantially as hereinbefore set
forth.

2. The combination of the means for direct-
ing jets against and over the material to be
excavated and elevated, and the excavating
and elevating device operating upon said
material after the refuse has been cleansed off
and washed away from it by the action of the
jets, substantially as and for the purpose here-
inbefore set forth.

3. The combination of the bucket-ladder,
the chain of buckets, and the nozzles from
which the jets issue to wash away mud, sand,
&c., from the material to be excavated and
elevated, substantially as hereinbefore set
forth.

4. The combination of the bucket-ladder, the
chain of buckets, the nozzles from which
the jets issue to wash away mud, sand, &c.,
from the material to be excavated and ele-
vated, and the supports by which the nozzles
are rendered self-adjusting, substantially as
100 and for the purpose hereinbefore set forth.

In testimony whereof I have hereunto sub-
scribed my name this 30th day of July, A. D.
1883.

FRED BROTHERHOOD.

Witnesses:

C. S. PITCHER,
R. A. BARTON.