University and Columbia University, have shown that the compound locomotive is decidedly more economical than the single-expansion; and, second, that where the management, engineers and firemen of a railroad have taken hold of the compound with the determination to give it a perfectly fair trial, it has not proved more costly in repairs and has maintained what we might call its laboratorial reputation for economy. We quote from a paper on the performance of a four-cylinder Baldwin, compound locomotive, by Richard A. Smart, Assistant Professor of Experimental Engineering at Purdue University, in which he draws the following conclusions: First, that there was with an increase of speed an increase of horse power and economy up to 270 revolutions per minute; second, the indications were that the power would increase for speeds considerably above 270 revolutions per minute; third, the increase in economy with increase of speed was chiefly due to a decrease of cylinder condensation; fourth, the average steam consumption of the compound was much lower than the lowest consumption shown by the single-expansion engine; fifth, the saving in steam shown by the compound locomotive would result in a saving in coal of from 18 per cent to 33 per cent.

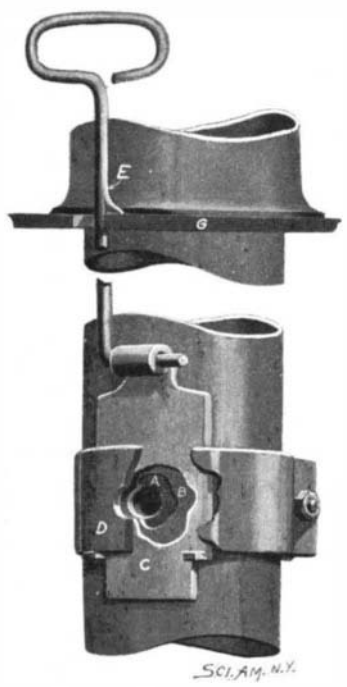
Perhaps the most celebrated locomotives turned out by these works are those which have been built to haul the extremely fast trains which are running between Camden, across the Delaware River from Philadelphia, and Atlantic City. These are of the celebrated "Atlantic" type in which the cylinders drive the rear pair of four-coupled drivers and the weight of the firebox is carried by a pair of trailers. Engine 1027 was built under guarantee to haul a train of eight cars (four coaches and four Pullmans) to Atlantic City, a distance of 55.5 miles, in sixty minutes; or to haul six cars over the same distance in fifty minutes, with a development of an estimated horse power of 1,400. In practice, however, this locomotive exceeded the guarantee by about 10 per cent. Another of the "Atlantic" type was built for the Chicago, Milwaukee & St. Paul Railroad, under contract to haul nine cars between Milwaukee and Chicago in one hour and forty-five minutes, with an estimated development of maximum horse power of 1,600. One of the latter engines exceeded the guarantee by four cars, hauling thirteen cars in the specified time, the train and locomotive together weighing 600 tons. Following on these excellent results the company proceeded to make accurate tests of 1027 to determine just what the locomotive was capable of. It was found that with an experimental train of twelve coaches the horse power increased directly with the speed until it reached 1,450 horse power at 70 miles an hour, and even at this speed the locomotive had a reserve of power to overcome grade resistance or to enable it to accelerate the train to a higher speed.

It is a well-known fact that at the higher speeds the single-expansion locomotive is subject to drawbacks in the shape of wire drawing of the steam, back pressure in the cylinders and overforcing of the fire, which are absent in the compound with its wider range of expansion and its milder exhaust. Careful tests have shown over and over again that there is about 25 per cent economy in a compound as compared with a single-expansion locomotive doing the same work. This is due to the less evaporation required to develop the necessary energy, together with the slower rate of combustion of fuel resulting from exhausting the steam at lower tension. Of course, it is understood that these results are only obtained, as we have before remarked, where the management and operatives of the road are in thorough sympathy with the compound, and are desirous of giving it every facility to show its best results.

The 20,000th locomotive, of which we present an illustration, is a further improvement in which it is sought to secure a more perfect balance of the reciprocating parts than is possible on the ordinary type. The high and low-pressure cylinders, instead of being arranged above one another in a vertical plane, are all carried in one horizontal plane, the high-pressure cylinders within the frames beneath the smokebox and the low-pressure cylinders on the outside of the frames. The low-pressure crossheads are connected with the main driving wheels by outside connecting rods as in ordinary practice. The main driving axle has two cranks, which are set at right angles to each other on each side of the center of the locomotive, and each crank is coupled to the crosshead of one of the high-pressure pistons. The crank on the axle and the crank-pin in the wheel for the corresponding high and low-pressure cylinders are set at an angle of 180 degrees, and the two axle cranks being set at 90 degrees results in the action of each high and low-pressure cylinder on one side of the locomotive quartering with the equivalent cylinders on the opposite side. As a consequence, an almost perfectly balanced engine is secured, and the amount of counterbalance required is reduced to a very low limit. The arrangement is the same as was used by Strong in his locomotive that attracted so much attention a dozen or more years ago, and it has lately been adopted with very good results on two or three of the English roads. Other special features of No. 20,000 are that it carries the Vanderbilt boiler and tender. In the former the firebox is cylindrical and corrugated, and in the tender the water tank is cylindrical, and the coal box is built at the front end of the tender and is, therefore, very conveniently placed for the fireman. The locomotive weighs in working order 176,510 pounds, of which 127,010 pounds are on the driving wheels. The weight of the tender loaded is 99,000 pounds. The driving wheels are 73 inches in diameter and the cylinders are 15 and 25 in diameter by 26 inches stroke. The boiler has a total heating surface of 2,793 square feet, of which 128 square feet are in the firebox.

VENT-CLOSING VALVE FOR PUMPS.

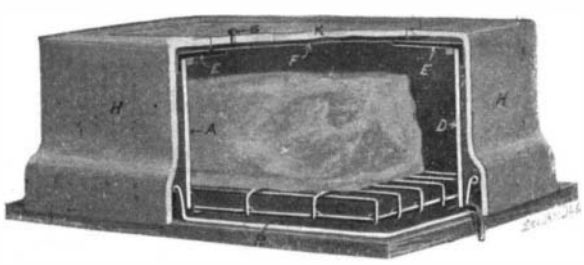
The device here illustrated is designed for use on pumps operated by windmills, and provides a means for closing the vent-hole of the supply-pipe of a pump whenever desired. It is well known that considerably more work is required to pump a given quantity of water when the vent-hole is open than when it is closed, thus prematurely wearing out the pump and windmill. With this device extra wear is entirely avoided, as the vent-hole may be readily closed whenever it is desired to use the pump. In our illustration the vent-hole may be seen at *A*. A metallic strip, *D*, encircles the pipe and is tightly clamped at the rear by a bolt. A portion of this strip directly in front of the vent-hole is off-set or struck-up from the surface of the supply-pipe to permit the insertion of a slide, *C*. To prevent leakage a packing of leather, *B*, is placed between this slide and the pipe, against which it is clamped. After the slide is inserted ears are turned up on its lower portion, and serve as stops to limit its upward movement. A rod passes through the upper end of the slide and serves as a handle to operate the device. This rod passes through a slot in the base, *G*, of the pump and is provided with a small detent or catch at *E*, which hooks over the pump base and serves to hold the slide in its highest position. When the slide is in this upper position the vent-hole is uncovered. If it be desired to close the opening, a forward pull of the handle-rod releases the slide, and it may be lowered to close the vent-hole. The valve, as has been shown, is of very simple construction and may be easily applied to any pump. Mr. J. E. Penner, of Kinbrae, Minn., has just received a patent for this device.



A SIMPLE DEVICE FOR PUMPS.

FOLDING ICE-BOX.

An article which should be of particular value for travelers and also for nurses who have charge of children has been recently invented by Mrs. J. B. Rogers, of Lakewood, New Jersey. The invention relates to an ice-box which may be folded up and packed away in a small space whenever desired. Our engraving shows the ice-box set up in position for use. Side leaves, *A*, and end leaves, *D*, are hinged to the bottom of a waterproof pan, *B*. A flanged top-piece, *E*, serves to hold the leaves in vertical position, their upper edges being wedged between the flanges and blocks on the under surface of the top, *E*. A lid, *F*, covers the opening in the top-piece to which it is hinged, and is provided with a knob, *G*, by which it may be raised. A jacket, *H*, of thick felt covers the ice-box and a flap, *K*, of the same material covers the lid, the felt serving to prevent the entrance of heat from external sources. A grid, *C*, placed in the bottom of the pan, *B*, serves to hold the ice and permit proper drainage of the same. The pan is provided with a drain-pipe to which a rubber hose is attached for drawing off the water. When desired, however, this rubber tube may be removed and the drain pipe closed by a cork or stopper.



A HANDY ICE BOX.

To fold the ice-box, the felt jacket is first removed, then the top, *E*, is taken off, the grid, *C*, lifted out, and the leaves, *A* and *D*, folded over. It will be noticed that the side leaves, *A*, are hinged at a higher point than the end leaves. The purpose of this is to permit the side leaves to fold over and lie flat on the end leaves. The grid is now placed on the folded leaves and is covered by the top-piece, *E*, thus forming a neat and compact parcel. When in position for use there is ample room in the box for bottles or other articles to be kept cool and it is therefore an accommodation which travelers will find indispensable.

Correspondence.

Seismic Disturbances and the Isthmian Canal.

To the Editor of the SCIENTIFIC AMERICAN:

The point urged, in the SCIENTIFIC AMERICAN of this date, in support of the Panama Route for an Interoceanic Canal, is hardly a safe one to insist on. Volcanoes are safety valves; the regions where they are are no more to be dreaded than are regions within the seismic belts where volcanoes are absent or remote. You would not advise a friend to select as his home an apartment house where the steam heating boiler had no safety valve, in preference to one where a safety valve was provided. The cases are perfectly analogous. Ometepe, Lago Nicaragua, is a safety valve at any rate. Nicaragua has not such subsidence shocks and surface undulations as has Panama, where there will never be a period of quiescence of sufficient duration to half finish the Bohio dam.

I realize that "geologists" galore have gone to Panama and reported that they did not feel earthquakes. So a man may go to Mississippi in January and say he saw nothing of negro disfranchisement—they don't vote there in January. Visitors of the "eminent scientist," the newspaper posing sort, stay on the Panama Isthmus, as a rule, less than a week. If they will go there, live with the people, camp out in the hills, as have I as an exploring naturalist, they will tell, if truthful, a very different story. Panama does have sudden shocks and quivers that would crack the pyramid of Cheops in twain; no Bohio foundations, on sand and 150, or more, feet below sea level, will ever withstand one such shock. Were there open volcanic vents near by these would be reduced or be wanting. The man who denies this has either never been long on the Isthmus, or—he is in the pay of the Panama people.

Remember Jamaica in the eighteenth century. Not in present geologic times has that island had a volcano in activity. Yet the fates that overtook Port Royal and again Savanna la Mar were far beyond that at St. Pierre in their terrible effects.

Mont Pelee's recent exploit may suffice to prevent the building of the Nicaragua Canal; it is not needed to prevent that at Panama. God himself could not build that and make it "stay put" without transcending His present laws. EUGENE MURRAY-AARON.

Washington, D. C., May 24, 1902.

The Current Supplement.

A very beautifully illustrated paper by Dr. F. A. C. Perrine, D. Sc., on the "Power Plants of the Pacific Coast," opens the current SUPPLEMENT. Messrs. Swinburne and Cooper's paper on the "Problems of Electric Railways" is concluded. Mention has been made in the SCIENTIFIC AMERICAN of the Richards-Archibald method of studying growing crystals by instantaneous photography. Messrs. Richards and Archibald's method is published in full. The famous Berthelot tells something of the radio-activity of matter. Naval affairs have not been neglected. Mr. William Laird Clowes describes recent scientific developments and the future of naval warfare; and S. W. Barnaby discourses on torpedo-boat destroyers.

An Improved Form of Apparatus for Producing Thin Films by Electro-Deposition.

Herr Endruweit, of Berlin, has patented an improved form of apparatus for producing thin films by electro-deposition. An endless metal band is first coated with potassium sulphide, and, after washing, is passed through a nickel bath of the usual composition. The thin film of nickel obtained in this way is backed by copper (by passing through a similar bath containing a copper salt in solution) and by tough paper, before being stripped from its support. A strong sheet or roll of paper faced with bright metallic nickel can be obtained in this manner, and the use of this material after relief-stamping and coloring, for wall-papers and for advertisement show-cards is said to offer many advantages. The electro-deposited "paper" is also reported to be useful for packing the stuffing boxes of high-pressure steam engines, and, if sold at reasonable rates, it is possible that there are many uses for which it may prove suitable.