SCIENTIFIC AMERICAN

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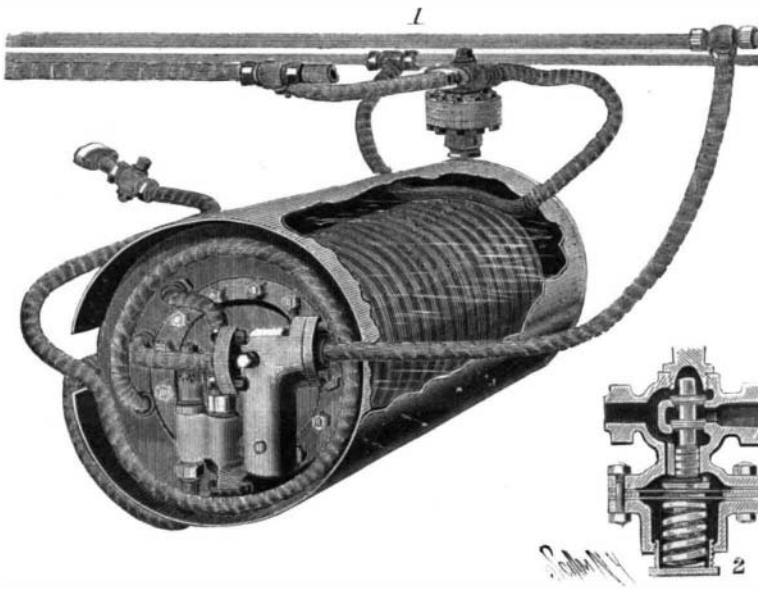
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXI.—No. 12.] ESTABLISHED 1845. NEW YORK, SEPTEMBER 16, 1899. [$3.00 A YEAR. WEEKLY.

COMPRESSED AIR TRACTION IN NEW YORK CITY—1,000 HORSE POWER COMPRESSING ENGINE.—[See page 184.]

COMPRESSED AIR TRACTION IN NEW YORK CITY.

The extensive compressed air plant which has recently been erected by the American Air Power Company at the corner of Twelfth Avenue and Twenty-fourth Street, in this city, is now in active operation, and the new compressed air cars which it supplies are in regular service on the Twenty-eighth and Twenty-ninth Street lines of the Metropolitan Street Railway Company. The compressing engine is of special interest, both on account of its abnormal size and power and the high working pressure which is obtained. The single compressing engine is of 1,000 horse power, and the compressed air, after the fourth stage of cooling, is



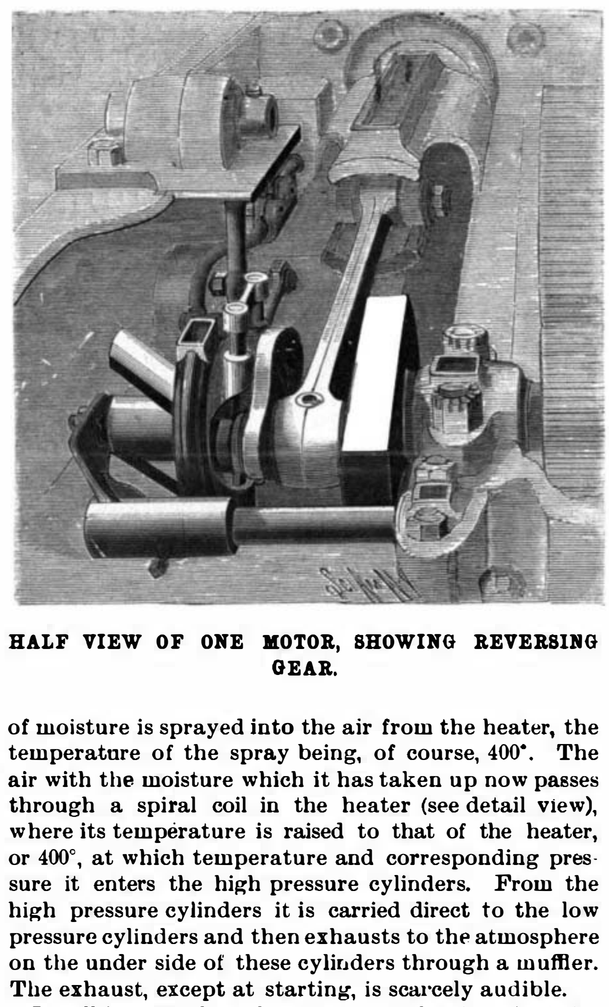
DETAILS OF THE HEATER AND REDUCING VALVE.

stored in the flasks at the high pressure of 2,400 pounds to the square inch. The engine, which is of the vertical cross-compound type, built by the Allis Company, of Milwaukee, is an extremely handsome specimen of the engine builders' art, and together with its massive brick foundations, it towers 60 feet above the ground floor of the building. Our front page engraving, which is taken at the level of upper floor of the engine house, shows only the engine proper and the upper courses of the massive brick piers on which it is carried. The diagram of the whole plant shows the compressors and the four inter-coolers situated on the ground floor of the building. The compressing engine has cylinders 32 inches and 68 inches in diameter by 60 inches stroke. Steam is furnished at a pressure of 150 pounds to the square inch, and working with the most economical point of cut-off the horse power is just 1,000. Our illustration shows the massive character of the construction, and as an instance of the size of its parts we may mention that the crank shaft is 22 inches in diameter, with bearings 20 inches in diameter by 36 inches in length, while the flywheel, which is placed centrally on the shaft between the cranks, is 22 feet in diameter and weighs 60 tons. The air compressor, which is carried directly beneath, is of the four-cylinder type, the compressing cylinders being securely anchored between the masses of brickwork which form the two legs of the piers. The low pressure cylinder is 46 inches, the intermediates are 24 inches and 14 inches, and the high pressure cylinder 6 inches in diameter, the common stroke, of course, being 60 inches or the same as that of the engine. The initial and first intermediate air cylinders are placed directly below the low pressure steam cylinder, and the second intermediate and high pressure air cylinders are below the high pressure steam cylinders. Each crosshead of the steam engine has four transverse arms, from which four distance rods lead down to connect with the corresponding crosshead to which the air pressure piston rod is attached. These rods are clearly shown on our first page engraving and in the diagram already referred to.

There are four sets of intermediate coolers for reducing the temperature of the air at each stage of compression, placed conveniently on either side of the foundations. Each of the two inter-coolers for the lower pressures consists of a cylindrical shell containing a set of vertical cooling pipes, while in the coolers for the higher pressures a single coil pipe is used; the air in each case passing through the pipes, which are surrounded with circulating water at atmospheric temperature. The action of the system is as follows: The air after compression in the low pressure cylinder is led through the first inter-cooler, from which it issues carrying a pressure of 40 pounds to the square inch. It then passes to the first intermediate cylinder, where, after further compression, it is led to the second inter-cooler which it leaves at a pressure of 180 pounds to the square inch. It is next compressed in the second intermediate cylinder, then cooled to atmospheric temperature at a pressure of 850 pounds, and finally it is compressed in the 6-inch cylinder and cooled to atmospheric temperature under a pressure of 2,400 pounds to the square inch, at which pressure it is led to a nest of storage cylinders in the charging room. The water used for cooling the air in the inter-coolers is taken from the North River, which is only a couple of hundred yards distant, through a 16-inch water main, and after passing through the inter-coolers the water is returned to the river through a discharge main of the same size. Adjoining the engine house is a charging plant and a car house. The cars on their return from a trip are run in on the tracks adjoining the storage cylinders, where suitable connections are made and a fresh supply of compressed air at the working pressure is fed to the storage cylinders, which are carried beneath the seats of the cars.

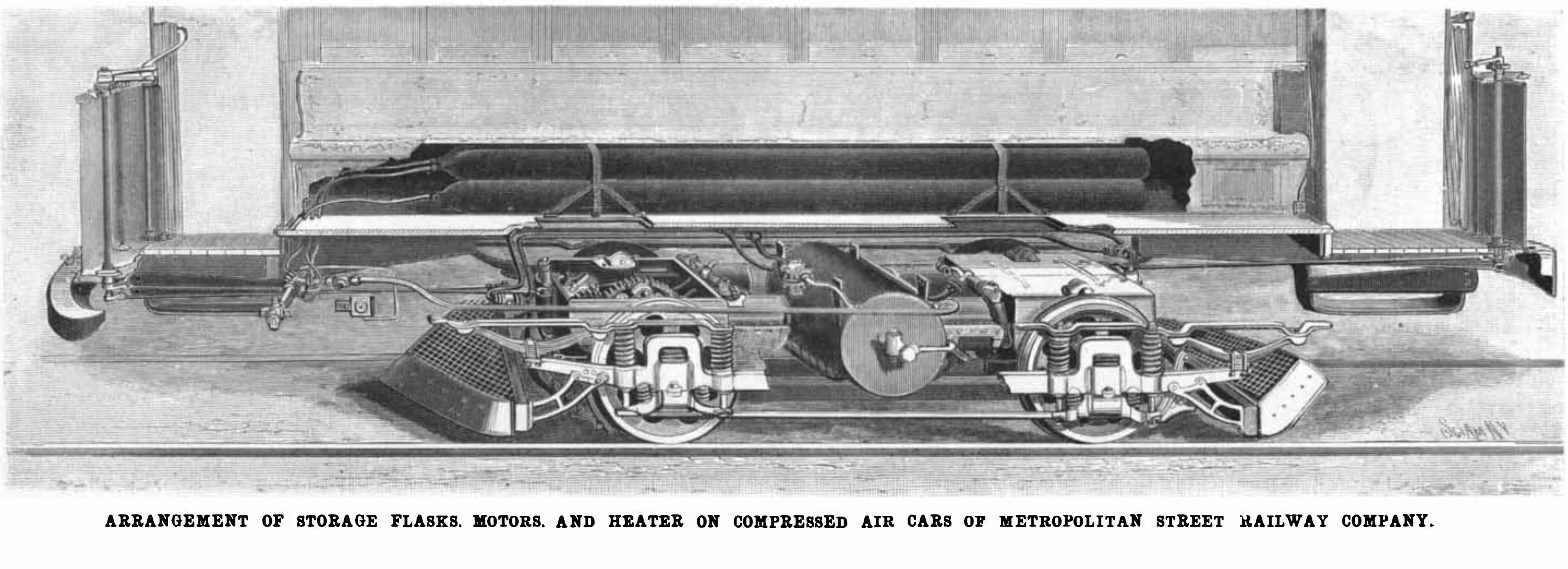
The cars which are being used in this service are practically the same in construction as the four-wheel cars which are used on the underground trolley lines. The car body weighs 6,000 pounds, the trucks 4,500 pounds, the air reservoirs 4,200 pounds, two motors weigh each 1,400 pounds, and the other parts and fittings of the car bring up the total weight to about 9½ tons. The air motors are carried one upon each axle, in two dustproof cast iron casings. Each axle is driven independently, one of them by the two high pressure motors and the other by the two low pressure motors. It will be thus seen that the cars are made to conform in respect of distribution of the driving power to the standard practice on electrically equipped lines. The high pressure motor has two high pressure cylinders, each 4 inches in diameter with a 6-inch stroke, and similarly the low pressure motor has two cylinders 8 inches in diameter by 6-inch stroke. In each case a 9¼-inch pinion is geared upon the crank shaft and meshes with a 21-inch gear wheel keyed on the middle of the car axle. The cylinders are bolted to the casing and lie outside of the same, while within the casing are the piston rods, crossheads, cranks, gears, and in fact all of the moving mechanism, and the whole is closed in with a cast iron cover, which on being lifted exposes all the moving parts for inspection or repairs. One of our engravings, showing one cylinder and its connections, is introduced to illustrate the construction of the reversing mechanism. The eccentric disk is not mounted directly upon the shaft but upon a pair of parallel guides which are pitched at an angle to the shaft, one above and one below it, and have a motion parallel to its axis. When the guides are thrust in toward the crank the eccentric disk is thrown up, and when they are drawn out the disk is thrown down, thereby giving a forward or reverse motion to the engine. The idea is not new; but it has been ingeniously applied in the present instance, and lends itself admirably to the peculiar construction of these motors. It does away with one eccentric and the usual link motion. The bottom of the casing is filled with oil so that the motors are self-lubricating after the fashion of the Westinghouse and other fast-running engines. The construction is very compact and the whole design well worked out.

The compressed air is carried in seamless steel flasks, which are placed beneath the seats of the car, three on each side, as shown in the accompanying engraving. The flasks are 21½ feet in length by 2 feet 5 inches in external circumference and they are tested, before being placed in service, to a pressure three times as great as the working pressure. From the ends of flasks the air is led through the heater, a wrought iron cylindrical reservoir which is supported between the two motors, as shown in the detail drawings of the car and the heater. The latter is charged with 60 cubic feet of hot water under a pressure of 210 pounds at a temperature of 400 degrees. After the pipe has passed through the heater where the air takes up sufficient heat to prevent the subsequent freezing of any moisture which it may contain, the air enters the reducing valve, of which we show a sectional view, where its pressure is lowered from 2,400 pounds to 320 pounds to the square inch. It then passes to the throttle valves at each end of the car, and thence to the injector, where a proper amount


HALF VIEW OF ONE MOTOR, SHOWING REVERSING GEAR.

of moisture is sprayed into the air from the heater, the temperature of the spray being, of course, 400°. The air with the moisture which it has taken up now passes through a spiral coil in the heater (see detail view), where its temperature is raised to that of the heater, or 400°, at which temperature and corresponding pressure it enters the high pressure cylinders. From the high pressure cylinders it is carried direct to the low pressure cylinders and then exhausts to the atmosphere on the under side of these cylinders through a muffler. The exhaust, except at starting, is scarcely audible.

It will be seen that the system of the American Air Power Company differs very materially from that of the Hardie system, which we have already described at considerable length in this journal. (See Scientific American of January 30, 1897.) In the latter system the air is allowed to pass freely through the hot water of the heater, but this method has the serious defect


ARRANGEMENT OF STORAGE FLASKS, MOTORS, AND HEATER ON COMPRESSED AIR CARS OF METROPOLITAN STREET RAILWAY COMPANY.

of being liable to carry excessive quantities of water into the motors, and of reducing the pressure in the heater from that of air to the pressure necessary to maintain the water at a temperature of 400°, and these drawbacks are avoided by the type of heater used on these cars. The moisture taken up by the air has the double advantage of giving a better packing at the joints and of serving to maintain the pressure throughout the full stroke of the pistons by continually vaporizing during the advance of the piston after the point of cut-off. The speed of the car is controlled partly by the variation of the cut-off and partly by the manipulation of the throttle, the control in both cases being operated from the platform, where there are two handles, the upper one working the throttle, the lower one the cut-off. The cut-off has four notches corresponding to three variations in the speed and the full stop.

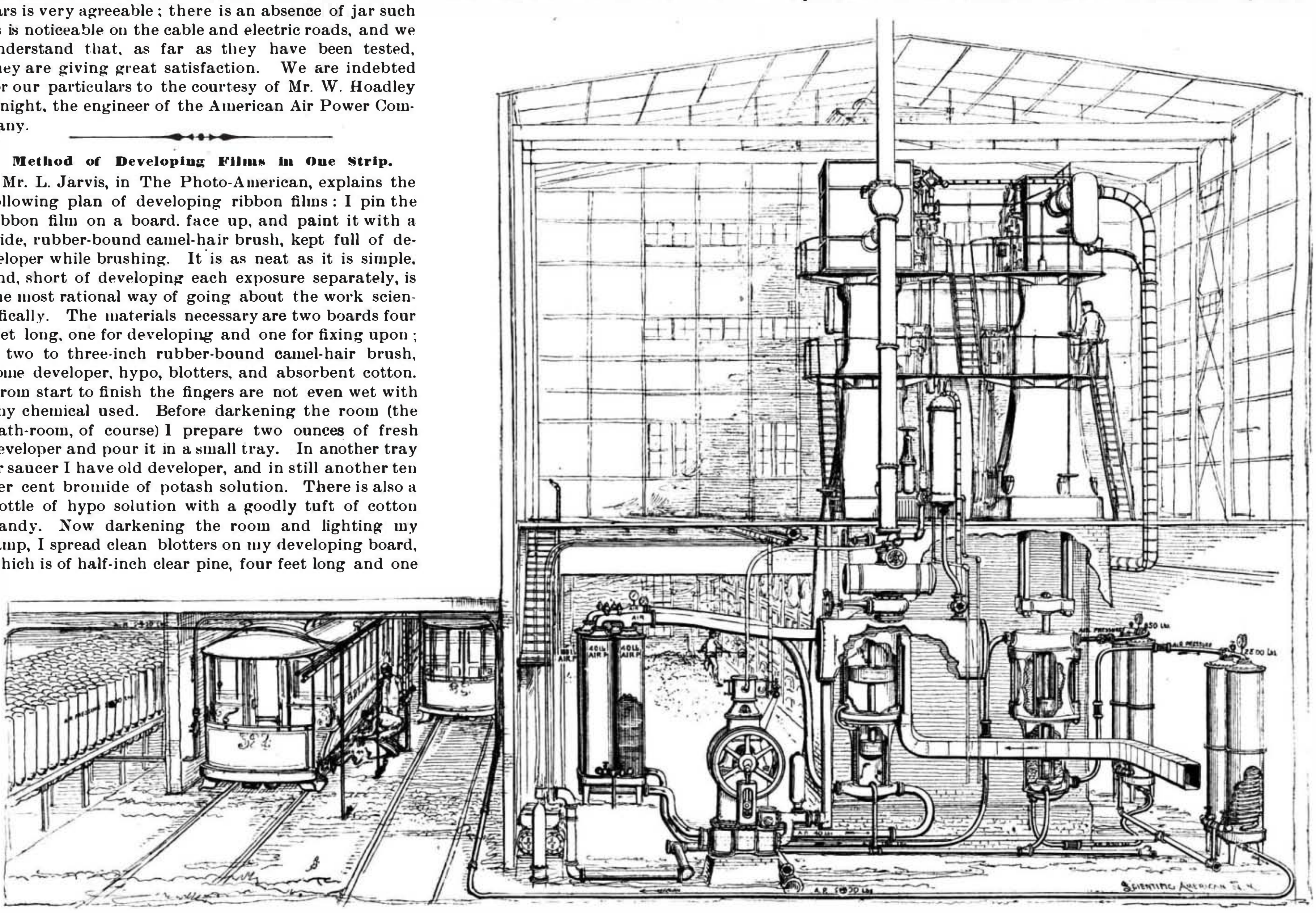
Under the present conditions of working, the cars have a capacity of fifteen miles with a charge of air occupying all space intermediate the seats, or the capacity could be increased up to as high as forty miles by placing on the cars as large a number of flasks as could possibly be crowded in, or it could be increased by raising the working pressure, a change which the company is now about to make. The motion of the cars is very agreeable; there is an absence of jar such as is noticeable on the cable and electric roads, and we understand that, as far as they have been tested, they are giving great satisfaction. We are indebted for our particulars to the courtesy of Mr. W. Hoadley Knight, the engineer of the American Air Power Company.

Method of Developing Films in One Strip.

Mr. L. Jarvis, in The Photo-American, explains the following plan of developing ribbon films: I pin the ribbon film on a board, face up, and paint it with a wide, rubber-bound camel-hair brush, kept full of developer while brushing. It is as neat as it is simple, and, short of developing each exposure separately, is the most rational way of going about the work scientifically. The materials necessary are two boards four feet long, one for developing and one for fixing upon; a two to three-inch rubber-bound camel-hair brush, some developer, hypo, blotters, and absorbent cotton. From start to finish the fingers are not even wet with any chemical used. Before darkening the room (the bath-room, of course) I prepare two ounces of fresh developer and pour it in a small tray. In another tray or saucer I have old developer, and in still another ten per cent bromide of potash solution. There is also a bottle of hypo solution with a goodly tuft of cotton handy. Now darkening the room and lighting my lamp, I spread clean blotters on my developing board, which is of half-inch clear pine, four feet long and one hand. Those whose dark rooms have no such convenient arrangement can, doubtless, heat the blotters on top of the dark-room lamp. The films remain moist with developer nicely, and it is no trouble at all to keep them covered if well wet at first. I never had a case of spotting yet from unequal application of the developer by the brush, and I have developed a large number of rolls in this manner. In winter, if the film is brittle, a drop or two of glycerine in the developer will be found excellent. There need be no hurry, no worry about results, and an easier way of improving a negative by local treatment could not be imagined, as it all lies before the operator as plain as a picture, and the spots which need bringing out or retarding, as the case may be, show plainly. In developing a number of strips at once in a tray, one cannot stop long to doctor little patches, because the other films need constant turning; so all get the same treatment practically, and we all know what the average is by such a manifestly imperfect method. Having finished developing, remove the pins, and, with a bit of blotter grasped between thumb and finger of each hand, remove the film to the other board, which is not covered. Pin it down securely, using about eight pins, and put it in the bath tub under the tap to clear it of stain. After a few moments remove it to the table and mop it over to be more exact, two grains to the ounce of water, will be strong enough to remove the greater part of the stain. All the stain should not be removed, especially from a thin negative, as the color in the film helps the printing in the shadows. After the acid treatment the full amount of washing should ensue, when nothing remains but to swab the film with glycerine solution, made of glycerine, quarter fluid ounce (a teaspoonful will answer); water, eight ounces, or one half-pint. After swabbing this solution over the negative two or three minutes, stand the board on end in a dry, but not too warm, room, until quite perfectly dried. Then throw away the mixed developer, swabs, also the blotters, if much soiled, wash the developing brush well, and all is through with. Each board must be marked, and always used for the same operation.

A New Textile Plant.

Consul Atwell writes from Roubaix that some years ago an explorer in Asia discovered a plant of silken fiber, used by the Turkomans for the manufacture of withes and cord and by the Canagues for woven goods. This plant, known as the Apocynum venetum, is a sort of bush with slender cylindrical branches, sometimes six feet high. It grows in Europe, Siberia, Asia Minor, the north of India, Manchuria, and Japan; but



GENERAL PLAN OF 1,000 HORSE POWER COMPRESSORS AND CHARGING STATION.

foot wide, and, unrolling my film, pin it, face up, on to the board, two pins at each end, and two on the edge, about in the center, being plenty. I generally develop two or three rolls of folding pocket Kodak film at a time. Now filling my brush with water, I gently brush all the film over, enough to soften the emulsion, and then in the same manner paint the strips with fresh developer, keeping the brush moving slowly over the film, enough to insure its being moist with developer all the time. The over-exposed ones come up first, of course, and those are first swabbed over with bromide, and then kept wet with old developer and bromide alternately. I apply these with a tuft of absorbent cotton held on a stick with a rubber band, stick and cotton to be discarded each day. The other films, meanwhile, have been developing nicely, and can be so manipulated that they finish with the rest, adding little touches of bromide, old developer, or alkali, as needed, with a round brush. The under-exposed films are given all possible encouragement by treatment with developer suited to their wants, and by a hot blotter of the right width slipped under them. This is a very effective accelerator, and helps the film as no amount of developer would. I keep a few blotters wound around the hot water pipe in summer, or the steam pipe in winter, and thus have them right at gently with a large swab of cotton containing all the hypo it will hold. Continue to drag the swab of hypo over the film, taking fresh solution as necessary, until it is completely fixed, which can be ascertained by unpinning one end and examining the back. I purposely do less swabbing at one end, so that, when that end is found to be fixed, it can be depended upon that the whole roll is. This saves examining more than a couple of inches at the end.

When this part of the work is complete, I place the board in the bath tub, film down, and let it float upon the surface of the water, which is kept changing. If the weather be warm, the film can be painted with alum solution during any stage of the performance. It is well to do this after fixing always, even though not apparently necessary, as the film may soften in the wash water. Washing is very thoroughly accomplished in fifteen minutes. Everything upon the film which we wish to wash off, the hypo, to wit, is heavier than water, and consequently falls off better in the tub when on top of the water, than it would were the water on top of it. If the film was much under-exposed, and prolonged development has left it considerably stained, it should be painted with a weak solution of tartaric acid after washing a few minutes. A saltspoonful of the powdered acid to a cup of water, or, it is not cultivated, and, up to the present, has been used only in the natural state. The branches die yearly, and in the spring new shoots start horizontally from the roots. It flourishes best where the land is under water during a part of the year, notably in the neighborhood of rivers that overflow at stated periods.

Under favorable conditions, the Apocynum develops quickly, and in a short time the branches form a thick growth, almost like a miniature wood. The best fiber is obtained by cutting the branches in midsummer, when the plant has obtained its full growth.

The attention of the Russian government was called to this plant in 1891. It is there known as the Apocynum sibericum, because it was first seen in Siberia.

It grows luxuriantly on the banks of the Amu Darya and the Ili, and the natives of these regions have used the fiber for many years for cord and fish nets. They value it not only for its great strength, but also because no care is required in its cultivation.

In 1895 the Russian government began to use it in the manufacture of bank notes, and since then the plant has been cultivated at Poltava. The results obtained thus far are considered excellent, and the time is doubtless near when the Apocynum venetum will take an important place in the textile market.