Figures 9, 10, and 11, show the reducing valve and regulating cock to chamber B, before referred to. It will be seen from the construction of the valve that the pressure of the spring determines the pressure in the chamber, irrespective of the greater pressure in the reservoirs, and thus keeps it constant, as the main supply is reduced from say 120 lbs. to the minimum or working pressure.

Plate 3 shows in figure 12, the machinery of an elevator with a hydro-pneumatic accumulator. The pump draws a supply of water from the square tank by pipe S, and pumps it by pipe D into the accumulator against a pressure of air. By the operation of the valve V the water under pressure passes by pipes P and C from the bottom of the accumulator to the elevator cylinder, to lift the car, and by pipe W and C from the cylinder to the waste tank to lower the car.

By the action of a self-acting regulating valve the pump works up to the required pressure and then stops, it starts again as soon as the water is drawn off for a lift.

The sections of the Sydney and San Francisco tram-roads are drawn to the same scale, in order to show by comparison the great difference in the grades.

DISCUSSION.

Mr. Pollock remarked that Mr. Selfe had had the honor of bringing the subject of air compressing prominently before the members of the Association in his able and interesting paper read at our last meeting, his principal object being to prove that the steam motors used at present on our tram lines would be advantageously superseded by Pardy air motors. Compressed air as applied to motors (above ground) was of comparatively recent date, and it was very difficult to get reliable data with which to compare his statements of the performances of the Pardy motor, so that he would have to draw his conclusions from what was known as to the economy of air when used in other machines. In mining and tunnelling, for working hauling engines, coal cutting machines, rock cutting and boring, and for many other purposes —since 1850 air had quite superseded hydraulic and steam power, its many advantages for *underground* work, outweighing its extravagance as a motive power. In our own colony the A. A. C. at Newcastle used it in their coal mine, and had a very efficient plant. The pressure that was generally used for these purposes, and which was said to give the best results was about 60 lbs. absolute, or about half the pressure that he understood, Mr. Selfe proposed to use in the Pardy motor—and at that pressure (60 lbs. absolute) the theoretic useful effect was said to be 50 per cent., but the highest practical results did not average more than 25 per cent., and as the pressure was increased, this percentage became less. Mr. SELFE had fully pointed out in his paper the reason of this loss, and there had been many attempts made to decrease it, principally in the line of surrounding the compressing cylinder with water, or injecting water into the cylinder, this of course cooled the air and prevented its expanding with the heat, but of course all the heat extracted was a dead loss. Sir WILLIAM SIEMENS suggested that a very perfect arrangement would be to take the water that was used in cooling the air in the compressing cylinder, and inject it again into the expanding cylinder, so that the heat taken from the air during its compression would be restored to it during expansion, by this means if the quantity of water injected were such as to keep the temperature practically uniform throughout the stroke, the whole of the loss at present arising from heating and cooling the air would be avoided. . He did not know whether this idea had ever been carried out, perhaps Mr. Selfe might be able to give us some information on this point. In comparing the pneumatic motor with the system we had in Sydney, Mr. Selfe took a London horse car carrying 40 passengers, and weighing (*empty*) 2½ tons, and suspended on it 1 ton of reservoir and ½ ton of machinery; now he thought the horse car would require to be strengthened, and in consequence be heavier, to stand 30 cwt. of machinery fixed to it, or they must be built with a very large margin of safety, and to take this car weighing with passengers 6 tons 14 cwt. up an incline of 1 in 19, at say 3½ miles per hour, would take 8.3 h. p., and 10 cwt. appeared to be very little to develop this power; however this was a matter that no doubt Mr. Selfe had given careful consideration, and he would keep to the figures in the paper. The percentage of live load to gross load was given at 25 per cent. when hal loaded with passengers, and 40 per cent. when the car was full; now when we considered that 75 per cent. of the power originally exerted was lost in compressing and expanding the air, wherever this might be done, and we were only dealing with 25 per cent. of the original power to make a fair comparison, the power exerted to move the passengers along was 6¼ per cent. when half loaded, and 10 per cent. in the case of the car being full, it was quite true that the balance of power was not used in destroying the permanent way, but *it was lost.* The above car was compared with two of our present cars weighing eight tons empty, and only credited with 45 passengers, now we did not see any reason that a car merely because it was drawn by a steam motor should be more than three times the weight of one propelled by air, thus allowing the cars to be the same weight for an equal number of passengers, it would bring the percentage of live load to dead load in our present system to 14 per cent. Again Mr. SELFE suggested that one man could drive the car and collect tickets. Presuming they were to maintain the present rate of speed, he thought it would be readily admitted that two men would be necessary, and as a car was only to carry 40 passengers *the wages item* would be considerably increased, not to mention the assistance required to make the ocnnection at the valves for recharging the reservoirs. There was no information given us as to how far the Pardy car would run with its stock of air, and it was well to bear in mind that any derangement of the machinery used for compressing the air at the end of the route would put a stop to the whole of the traffic, and the whole of the cars would remain stuck along the line until the air compressing machinery was repaired. Mr. SELFE asserted that our present tramway system is doomed, now he thought it did its work remarkably well. No doubt there was great room for improvement, especially in the permanent way which was generally admitted to be too light for the rolling stock. About 18 months ago we had some gentlemen who wished to replace our system by horse cars, and they argued very ably in its favour, and proved at any rate to their own satisfaction that it was the only system suitable for Sydney. He thought the pneumatic motor had a much better show than the horse car, which he always looked upon as a retrograde motion. The advantages of the air motor in avoiding all smoke, fire, &c. were undeniable, but as far as we were able to judge, they were more than balanced by the first cost and expense of running, but no doubt this was one of those cases where a pound of practice was worth a ton of theory, and he hoped Mr. Selfe would see his way to get an experimental Pardy car built and try it, and whatever our individual opinions might be on the subject, he was sure he but echoed the wishes of the members of this institution in saying they would render him every assistance and heartily wish him a successful issue to his enterprise.

Mr. Mackay said the Government could not afford to spend any more money on tramway experiments, especially when it was remembered that railways were about the most profitable investment in existence. He pointed out the inconvenience that would arise in the event of the breakdown of a car made on the system advocated by Mr. Selfe, although it appeared to have many advantages, and if a company could be formed to work it, it should receive concessions from the Government. There was a field in Sydney wide enough for the investment of a million of money in tramways, with a prospect of a good dividend. He still adhered to his former assertion that horse-tramways would in nearly all cases be more satisfactory than steam or compressed air tramways.

Mr. Greenwood asked whether any town could be named in which steam-trams were a success. The proof given by English towns was that they did not pay at all.

Mr. Henson said he did not see how the whole of the energy of the air-motor could be converted into heat, as stated in Mr. Selfe's paper. The inference was that the whole of the energy was lost. A cubic foot of air, compressed to one-fourth, would generate sufficient heat to melt brass according to this theory. The science of thermodynamics was one which still required a great deal of investigation.

Mr. Kerle asked for some information as to the relative cost of the different systems. The question was, Which was the best system? The paper stated that the cost of the cable system was about three and a half times that of the low pressure air system, and he thought this was a considerable difference, considering the cost of the air compressors, laying pipes, cost of cars and machinery, &c.

Mr. Poole said the great advantage of the system under notice was that there was a minimum loss of power from raising and lowering of temperature, owing to the fact that the pressure was a low one. With respect to the Sydney trams, the road was ridiculously weak, and that was one reason why the system was a financial failure. He believed the tramway might be made to pay if it were in the hands of a private company. He had inspected the stream tramway at Birmingham, and he found there that, after deducting for interest and depreciation, rates and taxes for use of streets, directors' fees, &c., the tramways paid. Yet in Sydney the fares were practically double. There was not that closeness and efficiency in the management of our tramways that there would be if they were in the hands of a company. He also said that if they doubled the cost of wages paid in England, and added 25 per cent. for the fewer hours worked in Sydney, they would account for almost all the loss on our tramways.

Mr. Cruickshank said provision had not been made for duplicating the machinery in the system under notice. This would be necessary in case of a breakdown. One good point about the steam motor was that it was self-contained, and if any accident happened to it the rest of the cars would not be stopped, as would be the case with cable and compressed air tramways. He had been informed that the cost of working the trams in Sydney was about eight times that of some systems in England. It was the cost of labour that was killing our tram system.

Mr. Trevor Jones said it was unfortunate that in reading a paper upon a subject that had only recently engaged public attention the author was generally unassailable, not perhaps because his facts were incontrovertible so much as that he was generally the only one who had made a special study of his subject, and both time and experience were necessary to the critical discussion of his theories. Mr. Selfe had, however, in his paper cleared the road for discussion by presenting his facts and conclusions in so gradual, clear, and systematic a manner as to offer every advantage to his critics should any of us have had the time to digest them. Some years ago he had been party to a discussion on this subject, and it seemed to be an understood thing that to utilise compressed air as a motive power, the motor should carry sufficient air for the journey out and back, and this seemed to entail the conveyance of such heavy reservoirs that the notion seemed not to be sufficiently promising to pursue further. The other difficulty of the loss of efficiency by the radiation of the heat resulting from compression was just touched upon, but as not much was known on this point, and, moreover, as it only added to the other shortcomings, it did not enter much into the discussion. According to Mr. Selfe, M. Megarski seemed to have been among the first to realise the fact that a greater efficiency was procurable by using large reservoirs with low pressures, and to have successfully applied the idea; but even he seemed to have been wedded to the notion that the reservoir must carry sufficient air for the in and out journey, and that notion entailed the carrying of a large heavy reservoir. The requirements of commerce had brought about a more intense study of the natural laws attending the compression of air within the last few years, and now we had at our disposal accurate figures whereupon to build up theories and uses, which, if available to Mr. Mort and his coadjutors, might have rendered success in his pursuits less arduous. The production of cold, the ventilation of mines and tunnels, the actuating of rock drills and other machinery at a distance and at low depths, the impelling of torpedoes, &c., &c., all brought scientific thought to bear upon them, and each branch contributed its quota of knowledge for the benefit of further investigation. With these new facts at his disposal, Mr. Pardy observed that air at low pressures returned more of its efficiency in work than that at high pressures, because it did not lose so great a proportion of the heat generated in its condensation, and adopting medium-sized reservoirs in his motors, conceived the idea of having reservoirs along the track fed with compressed air from a central engine by pipes, and of feeding his reservoirs at intervals along the track. Mr. Selfe's quotation of Mr. Milliken's schedule of benefits derivable from its use seemed irresistible, but while it seemed to commend itself to the Sydney authorities as deserving of being experimented upon, it might have shortcomings of which none but those concerned actually in its use knew of. Nevertheless, with the terrible wear and tear brought about by heavy rolling stock running on light roads, it was gratifying to look upon schemes developing which offered relief from this combination of two incompatible conditions. The fact that the car was also the motor, the reservoir of power and also the machinery being disposed beneath the car, secured the benefit that if the car will negotiate all its grades when empty it will do so when loaded, as each passenger brought his weight to induce further adhesion when wanted. It was perhaps a drawback that every car should require such costly attachments, but this was a matter requiring adjustment financially, and Mr. Milliken, at any rate, saw nothing but encouragement here. He had not here pretended to speak critically, for an excellent reason, viz., that his pursuits were not such as to bring him into contact with the subject. His excuse for saying so much must be the interesting nature of the subject.

Mr. Van de Velde remarked :—He regretted very much that he was prevented to be present at the last meeting to hear the reading of Mr. Norman Selfe's paper on compressed air and its application. He had received this morning the advance proof of it, and he read it with great interest, and considered it as a most valuable contribution. After having studied this paper, it seemed to him evident that the Pardy's low pressure traction system for tramways presented very serious advantages over horse power, cable, electric, coal, gas, and high pressure air systems, and, certainly, if there was no other better system in the world, he thought that the Government ought not to hesitate in substituting the Pardy system for the remarkable system now in use in Sydney and its suburbs. But he was rather surprised to see that in his very valuable paper Mr. Norman Selfe did not even mention the locomotives without fire-boxes of Leon Francq, which were in use in several places in France. They had been adopted by the metropolitan railway of Vienna, by the tramway company of Batavia, and were recommended for the intended metropolitan railway of Paris. It seemed to be proved that the Leon Francq system was the best and most economical in existence, and therefore he did not admit the conclusions of Mr. Norman Selfe's paper when he said that the low pressure system was the best to take the place of the system adopted in Sydney. He was not prepared to-night to go into the details of this system of traction, but if he was allowed he would make this the subject of a lecture for a subsequent meeting, and hoped he would have no difficulty in proving the superiority of this system over the low pressure air system advocated by our learned colleague, Mr. Norman Selfe.

Mr. A. C. Mountain, said :—Although his leisure time had been too short to enable him to study Mr. Selfe's paper as its merits deserved, and notwithstanding that its subject was one on which probably few engineers in Australia could pretend to speak with authority, he felt that it would be but poor recognition of the trouble and time devoted by its author to explaining the principles of *Pardy's Low Pressure Tramway System* if members did not generally express some opinions thereon, and thereby express their appreciation of the exceptionally exhaustive and able paper which we were to-night invited to criticise. The explanation of the practical disadvantages attendant on the use of air under high pressure—involving loss of efficiency, increased dead-weight (to ensure sufficient strength in the reservoirs with no corresponding capacity for extra carrying space), &c.—were all very clearly and convincingly argued out ; and the manner in which, by the substitution of low-pressure engines, these disadvantages were minimised, and other benefits obtained by the use of the latter system was also suggestively treated ; nor was the practical or financial part of the question omitted, as we were told that its application required so much less outlay than either the high pressure, cable, or electric systems, and that its introduction into this city could be effected without appreciably disturbing the existing permanent way. As we were all aware, the present tramway system in Sydney had not been a success financially, nor did it appear to have been entirely satisfactory if viewed from the popular stand-points of comfort and suitability for city streets. Although this was so, yet, as he before maintained in a previous discussion on the subject of Sydney tramways, it was very doubtful whether the actual loss incurred in working our tram lines was to be entirely chargeable to the "motor" system. The initial error of the work lay in the original use of permanent way in all respects too light for the intended service, which had resulted in continual and costly repairs for maintenance, besides increasing the wear and tear of rolling stock. But, first of all in the item of expenses, came the simple fact that it was a *state concern*, and as such could, not in cost of working and economy of administration, be compared with similar enterprises conducted by private companies, who were so much more at liberty to act as they thought best in the interests of their respective shareholders, untrammelled by undue pressure or influence of Parliament or Ministers. A hint at this part of the question was sufficient, as the effect of such official control was pretty well understood, and needed no amplification. He merely wished to direct attention to the fact that the financial success of a given system of tramway as at present controlled in Sydney was not *of necessity* assured by the adoption of a system that might, under different conditions of management, be worked to advantage. In comparing costs of working different methods, this fact—which was an important co-efficient in the calculation—was apt to be overlooked. Hence his reference to it. He should like to have seen some estimates of the probable cost of each of the light-weight air cars, with the first cost and working expenses of a central station and compression pumps with air mains and valves necessary to feed a service, say, between the Railway Station and Bridge-street. With all the advantages claimed, it still was apparent that each car to carry about 40 passengers must have the mechanism of an engine fitted with reservoirs, &c., and must be rather costly. If an experiment could be attempted at a reasonable cost on one of the metropolitan tram lines, he should hope that the Commissioner for Railways would see his way to authorise it, as it certainly was the possessor of many advantages over the present "motor" system, if only on the score of absence of noise, dust, grease, and danger to persons driving horses. In establishing a comparison between his system and that of the "cable" lines, Mr. Selfe pointed out the necessity that caused an ingenious American engineer to devise a means of overcoming the abnormally steep gradients of San Francisco, which had hitherto been unattacked by any of the hitherto-practised methods of mechanical locomotion, and drew the inference from that fact that the cable system was only suitable, on account of its cost and the dead-weight carried, for such extreme inclines. This was apparently a very fair deduction, for the first cost of a cable line was undoubtedly heavy, and the wear and tear of wire rope amounted to from 70 to 100 per cent. annually, in our own experience on ordinary work; yet a few months since when he had he opportunity of making a minute inspection of the cable line running from Melbourne to Richmond and Hawthorne, he was surprised to find that notwithstanding the heavy outlay, the line was working so well, and was so popular that the shares of the company were selling at a high premium. The dangers of the cable line practically was the discontinuance of all the traffic on the line when the cable strandted, an event which, he learnt when there, should always be forestalled once the men became efficient, by detection of the weak strand and repairing same during the night. He also observed that the shunting of cars from the "up" to the "down" line was effected by manual pushing, which was not pleasing to the eye; but otherwise there was no doubt that the system was in great favour with the good people of Melbourne, and if Mr. Selfe could introduce as comfortable and sightly a service as our sister city possessed, and at one-quarter the cost, he would assuredly gain the gratitude of all Sydney residents. In any case Mr. Selfe deserved our hearty thanks for the very interesting paper that he had prepared for the Association.

Mr. Shellshear remarked that he took exception to the statement in the paper that "in the compression of air the whole of the energy exerted to effect its compression is converted into heat," the fact being that in the act of compression work was expended firstly in overcoming the elastic resistance of the air, and secondly in raising its temperature. After compression the work expended in overcoming the elastic resistance of the air could be given back as useful work; when the air was expanded in the air engine, the work done in raising the temperature of the air was lost on account of radiation and absorbtion He referred to the hydro-pneumatic elevator and eulogized on its simplicity. Regarding the low pressure air system for tramways, this system promised considerable advantages over the high pressure system; but he expressed doubts as to it being able to cope with the heavy traffic and high speeds necessary in working the Sydney traffic. He pointed out that the Sydney tramway system was really a system of street suburban railways. Referring to the traffic at the busy times of the day it was mentioned that it was an everyday occurrence to see a tram engine drawing two cars with as many as 200 passengers, and taking the approximate weight of the engine as 16 tons and the cars as 8 tons each, this gave a dead load of 32 tons, and taking Mr. Selfe's estimate as 15 passengers to the ton, the paying load would be 13½ tons, or something like 30 per cent. of the total load, which showed that the rolling stock was not so unreasonably heavy as was supposed. When it was remembered that during the busy parts of the day with the present heavy system the trams followed at intervals of about cne minute, and that each tram carried from 90 to 200 passengers, it was very difficult to see how trams with cars only capable of carrying 40 passengers could accommodate the traffic. He pointed out that the great difficulty with the Sydney trams was that the road was very much too light, and that the small stock of engines had been overworked, and that as a consequence heavy night repairs had to be carried out at a ruinous expense. The remark that it was impossible to work steam trams at a profit was an insult to engineers. With a good strong permanent way and a sufficiently large stock of engines to enable repairs to be done in the day time, there was no reason why the steam trams should not pay their way. He concluded with an expression of thanks to Mr. Selfe for the trouble he had taken in getting up his most valuable paper.

Mr. Selfe, in replying, said it was impossible at that late hour to deal with all the questions raised by the various speakers, or to take them systematically, but he would try to answer the principal points referred to. Several speakers, as the President and Mr. Poole, seemed to attribute the whole of the failure of the present system to the lightness and unsuitable nature of the permanent way, and he, Mr. Selfe, had seen much heavier lines (in one case with rails six inches deep), laid for horse cars, but one of these gentlemen admitted that the weight of an engine and two cars in Sydney was nearer 32 tons than the 24 tons put down for it in the paper, and claimed that for a short part of the day the average load was nearly 200 passengers. Nobody, however, denied the statement of the paper that on many of the lines the average of the whole day was only about 20 passengers per train, and thus the arguments of the paper were really strengthened very materially if 32 tons of dead weight were to be taken to draw 20 passengers as the average work instead of 24 tons for 45 passengers, and in fact from the nature of things, such must be the case.* The Sydney tramways were principally employed in conveying passengers to and from the suburbs ; they were in fact suburban trains running through the streets, and did not do the work and earn the money by traffic through the crowded business streets of the city that tramways in most cities did. The author therefore held that it would be better to send five cars with 40 passengers each, instead of one train with 200 as at present, for the busy hours ; and let four of these cars lay up when not wanted, instead of running themselves and the road to destruction for no purpose, as the heavy tram trains do now, for the greater part of the day's work. It would probably be found that the first cost of five pneumatic cars would hardly exceed the locomotive and carriages to carry the same number, and it was certain the wear and tear would be so much less as to hardly admit of comparison. With regard to Mr. Cruickshank's fear that duplicate compressors would be necessary—of course spare and reserve compressing power would be provided, and perhaps on some streets liable to settlement, and where mains might be broken, it would be advisable to put double lines of pipes for extra security, but, at any rate, the percentage of reserve power would certainly be much less than with locomotive machinery, and as Mr. Cruickshank had just reported on stationary machinery at the Botany Waterworks, that had been in uninterrupted use for over 30 years, he was in a position to know what stationary engines and boilers could be expected to do. Mr. Mackay's idea that we wanted tram cars in Sydney very close to the ground, was met by two designs on the table, where the passengers sit back to back over the two long air cylinders, and the driver or conductor has a passage down the centre, in these cases the wheels are covered up, and the foot board was only a short distance above the ground. Mr. Henson's objection to the statement that

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*It should be pointed out that there are several classes of motors working the Sydney traffic, and that on the branches where the traffic is light, the lines are worked by the lighter class of engines and a single car ; therefore the proportion of dead to live weight is not so great as would appear from Mr. Selfe's remarks.—Ed.

all the energy of compression is converted into heat is a common one, but although the author may not always have expressed himself in the clearest language, all his statements and tables were based on the highest authorities, nevertheless some clerical errors had crept into the proofs that would probably be set right before printing. The author did not go forth to seek this system, but it had been brought under his notice in such a way, and had so much to recommend it, that until he heard some sounder argument or more valid reasons put forth than had been used in the discussion, he should continue to think it well adapted for the wants of Sydney.

TABLE A SHEWING THE RELATIVE QUANTITY OF WORK REQUIRED TO COMPRESS A GIVEN VOLUME AND WEIGHT OF AIR, BOTH DRY AND MOIST; ALSO RELATIVE VOLUMES WITH AND WITHOUT INCREASE OF TEMPERATURE FROM COMPRESSION.

From CORNET & MALLARD.

Tension in Atmospheres.	Compression at a Constant Temperature. Marriott's Law.			Compression with increase of Temperature.						Loss of Work in Compressing one Cubic Metre in Killogram-metres.	Per centage of Work of Compression converted into Heat and Lost.	Final Temperature if Water is used in Compression.	Per centage of Water to Air required.	Foot Pounds to compress 1lb. Air.	
	Volumn	Work of Compression. Cubic Metres in Killogram-metres.	Work of Compression. Cubic Feet in Foot Pounds.	Volumn	Work of Compression. (Dry.) Cubic Metres in Killogram-metres.	Work of Compression. (Dry.) Cubic Feet in Foot Pounds.	Temperatures. (Dry.) Centge.	Temperatures. (Dry.) Fah.	Ratio of Greater to Less Temperature. Absolute.	By increase of Temperature alone.				Dry.	With sufficient Moisture.
			Deduced from 3.			Deduced from 6.						Fah.			
1	1						20	68	1.0			68			
2	.5	7199	1468	.612	7932	1618	85.5	186	1.222	733	.092	111	3.0	23500	22500
3	.333	11356	2316	.459	13360	2725	130.4	267	1.375	2004	.150	135.5	4.0	37000	35000
4	.25	14260	2909	.374	17737	3618	165.6	330	1.495	3477	.196	153.5	4.8	48500	45000
5	.200	16580	3383	.320	21209	4326	195.3	384	1.595	4629	.213	167.	5.4	58500	52500
6	.167	18475	3768	.281	24310	4959	220.5	429	1.681	5835	.240	179	6.0	67000	60000
7	.143	20038	4087	.252	27048	5517	243.2	470	1.758	7040	.260	190	6.4	75000	66000
8	.125	21422	4370	.229	29518	6021	263.6	506.5	1.828	8096	.274	...	...	......	.....
9	.111	......	......	.210	......	......	282.	539.6	1.891	......	....	......	...	......	......
10	.100	.....	......	.195	....	......	299	570.2	1.950	......	......	......	...	......	....
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

TABLE B SHEWING THE RELATIVE EFFICIENCY OF COMPLETE EXPANSION AND FULL PRESSURES WITHOUT EXPANSION, ALSO INITIAL AND FINAL TEMPERATURES.

From M. MALLARD and D. K. CLARK

Ratio of Initial to Final Pressure.	Ratio of Final to Initial Absolute Temp.	Air admitted the whole stroke.				Air completely expanded.				Ratio of Efficiencies obtained from Full Pressures in Cylinders and Complete Expansion.	
		Temperatures Centigrade.	Temperatures Fahrenheit.	Theoretical Efficiency.	Theoretical Efficiency.	Temperatures Centigrade.	Temperatures Fahrenheit.	Theoretical Efficiency.	Theoretical Efficiency		
	Clark.	Mallard.	Clark.	Mallard.	Clark.	Mallard.	Clark.	Mallard.	Clark.	Mallard.	Clark.
				Expansion only.	Compression and Expansion.			Expansion.	Compression and Expansion.	Expansion.	Compression and Expansion.
1	1	20.c	62 Fah.			20 Cen.	62 Fah.				
2	.855	—22.4	—14	.82	.66	—33.4	—33	.855	.82	.95	.80
3	.806	—36.9	—40	.72	.52	—60	—81	.806	.73	.90	.71
4	.782	—43.2	—52	.67	.44	—77	—111	.782	.67	.86	.66
5	.768	—48.0	—60	.63	.39	—89	—133	.768	.63	.82	.62
6	.758	—51.0	...	.60	...	—98	...	.758	...	.79	..
7	.751	—53.0	...	.57	...	—106	...	.751	...	.74	...
8	.746	—54.5	...	.55	...	—112.7	...	.746	.	.73	...
9	.742	—55.6	...	.53	...	—118.1	...	.742	...	.71	...
10	.739	—56.5	—75	.51	.27.5	—122.9	—193	.739	.51	.69	.54
1	2	3	4	5	6	7	8	9	10	11	12