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THE AUTOMATIC HYDRAULIC GOVERNOR.

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The object of this paper is to describe a Hydraulic Automatic Governor, and show from actual tests the value of the machine as a water economiser.

The employment of hydraulic power-water, whether from the Hydraulic Power Company's mains, high and low pressure accumulators, or City Water Supply, is a very expensive method of working the passenger and goods elevators, as it is at present in the majority of cases applied, where variable loads are carried. Even taking into consideration the great improvements made of late years in the economical working of hydraulic elevators, the fact still remains that, with the exception of a few isolated cases, the consumption of water is not in proportion to the load carried, but is based entirely on the total carrying capacity of the elevator.

The author now proposes to describe the Automatic Hydraulic Governor, and then quote records of actual trials made, with the governor attached to high-pressure elevators. The Automatic Hydraulic Governor is an invention of Mr. G. S. Duncan, M. Inst. C.E., Consulting Engineer to the Tramway's Trust, and has been designed and constructed for the purpose of economising power-water. It can be applied to all classes of hydraulic elevators with great advantage, where variable loads are raised or lowered. It is eminently adapted for controlling the water supply to passenger and goods elevators

worked either by high-pressure water from the Hydraulic Company's mains, low-pressure elevators where power-water is obtained either by means of steam or gas engines, or from the City Water Supply.

The proprietors of low-pressure elevators will, by adopting the Hydraulic Governor, be enabled to make use of the Hydraulic Company's efficient high-pressure water service, without alteration to the existing elevator cylinders, and a large annual saving will be effected in the present cost of operating the elevator. The average space required for each governor is approximately seventy cubic feet. Its dimensions are about two feet nine inches in diameter, and about six feet in height. It can be erected in any convenient space, in the cellar or yard, and, if desired, can be partly placed below ground.

The existing elevator cylinder and governor are connected by a pipe, and no alteration to existing elevators requires to be made. The accompanying drawing (Plate XXXII.) shows the details of the governor, from which it will be seen that it is composed of three chambers, viz., A, B, and C, and it has been ascertained by actual investigation, that in the majority of cases a three power governor, similar to the one about to be described, will meet all the requirements necessary for the varying loads of the passenger and goods elevators in the buildings in and about the city, but, if necessary, these chambers can be extended to any number required to suit the loads carried on any particular elevator. Taking a governor similar to the one shown as an example (a high-pressure governor), it will be seen that the lower cylinder is divided into two chambers, viz., A and B by the piston P. The chamber A has a cubical capacity equal to that of the displacement of the existing elevator ram, or stroke of piston. That is to say, that assuming the full stroke of the ram or piston of the existing elevator uses ten gallons of water, the chamber A of the governor would require to be made sufficiently large to contain ten gallons, but a small margin is always allowed for to meet the leakage that

takes place through the packings. The other chambers, B and C, are then proportioned to give the greatest saving efficiency to the governor possible in practice, and these proportions are fixed by keeping a record of the work done on each particular elevator for some time before attaching the governor, and designing its proportions so that it will give the best result for the work it has to do.

The two chambers B and C are connected by means of a pipe to what we will call the automatic feed valves, which are operated by means of a rocking shaft, levers, &c., actuated by a spring, attached to a ram working in a cylinder that is connected to chamber A by a small pipe F.

The chambers B and C are also connected with the waste water tank O by means of the pipe T, and retention valves X.

The chamber A, and the elevator cylinder are connected by means of a circulating pipe, N, and stop valve.

The high pressure is connected to the automatic valves from the main operating valve, and the governor is then ready for working. As will be seen, there are stop valves, both on the high-pressure feed, the circulating pipe N, and on the waste water pipe T, so that at any time the governor can be cut off at a moment's notice, and the elevator run under the old conditions.

The action of the governor when operating the elevator is as follows :—

When a load is put in the elevator cage the main operating valve is opened by the driver in the usual way, and the back pressure due to the load is transmitted through the circulating pipe N to the chamber A, and in turn to the ram R, through the pipe F. The spring S is compressed an amount due to the load in the elevator car, and so actuates the rocking shaft and opens the automatic valves, which are adjusted to open and shut under given loads.

The high-pressure water will feed through the valve which is connected with the chamber, either B or C, or through both

valves at once into chambers B and C, according to the load in the elevator cage. It will be seen from this that the governor is entirely automatic in its action, being beyond the control of the lift attendant in every way. He starts and stops the elevator with the hydraulic governor attached to it, in exactly the same way as at present, there being no extra gearing placed inside the elevator cage. Assuming that a small load is in the cage, the valve to feed chamber C would open and admit high-pressure water, which presses on the ram in chamber C, which in turn presses upon the water in cylinder A by piston P, which again presses on the elevator ram through pipe N, and raises the cage.

While the high pressure water is being fed into chamber C, water from the waste water tank O feeds into chamber B, the object of this being to always keep the cylinder which is not working full of water, so that in the event of a larger load coming on to the cage during the stroke, say at the first floor of a building, and requiring the power from chamber B instead of chamber C, there is no space to fill up (of high-pressure water), and every inch of stroke is in this way saved by slack water, fed from the waste tank O. If a medium load is in the cage the valve to feed chamber B is opened, and admits high-pressure water in chamber B to the top of piston P, which presses on the water in chamber A in an increased proportion to what it did when a light load was in the cage, and thus raises the load; water from waste tank O feeding chamber C at the same time.

If there is a full load in the cage both valves open and admit high-pressure water to chambers B and C, which together press the water in chamber A, by piston P, thus giving the full pressure on the elevator ram that it would have had under the old conditions for a full load.

The whole action under any condition takes place in a moment, there is no time lost in waiting for the valves to open or shut, and unless you were told that the governor was

attached to an elevator in which you were travelling, it would be impossible to note any difference in the running of the elevator.

The Automatic Hydraulic Governor has passed out of the experimental stage, and is now operating some of the elevators in Melbourne, with great advantage to the proprietors.

In addition to regulating the quantity of power-water used for ascending loads, the governor, by some slight additions beyond what are shown on these drawings, is capable of producing power-water by the weight of descending loads.

In passenger elevators, on the average, it is estimated that about 15 per cent., and in goods elevators, about 30 per cent, of the total water now run to waste could be conserved, on descending loads the governor can return this water either to the Hydraulic Company's mains or to an accumulator. The former method, however, is not allowed by existing hydraulic companies.

It has already been shown that the governor uses water in proportion to the load carried, and it has been ascertained by most careful investigation, made on some twenty-seven passenger elevators in Melbourne, that the average number of passengers carried per trip is only 1·49. Furthermore, on some of the busy elevators as many as 30 trips per hour are made. From this it will be seen that the monetary saving by using the governor should be very large, and the results fully bear out expectation.

We will take for example, elevators to which the governor is now fixed, viz:—

Melbourne Chambers,
Oxford Chambers,
Victoria Buildings,
City of Melbourne Bank Chambers.

The saving effected in Melbourne Chambers, at a trial lately made by request of the proprietor, was over 50 per cent. of the power-water, which would have been used if the governor

had not been attached. For example; If this elevator had been consuming say 60,000 galls. per quarter, under the old conditions, the rate would be 10s. per 1,000 gallons, or £120 per annum. The saving by the governor being say 50 per cent., or 30,000 gallons, the rate would be 10s. 10d. per 1,000 gallons, or £65 per annum, giving a monetary saving of £55 per year. Comparisons of a similar kind, applicable to various consumers, can be supplied *ad infinitum*, still showing larger monetary savings. For instance, taking a large consumer the savings would be somewhat as follows:—A consumer of 250,000 gallons per quarter would be charged per schedule rate, 6s. 8d. per 1,000 gallons, which would, in the gross, amount to £333 6s. 8d. per annum.

Taking the saving by the governor at say 50 per cent., which would be 125,000 gallons per quarter, the charge per schedule rate is 8s. 4d. per 1,000 gallons, or in the gross, £208 6s. 8d. per annum, which shows a saving of £125 per year.

The saving effected at Oxford Chambers is 47½ per cent., at Victoria Buildings, 43 per cent., and it is worthy of note that the traffic on these two elevators is above the average.

The details of these tests are given in the following table. All of these being large consumers the monetary savings are necessarily very large. Other governors are being constructed, one for the Mercantile Bank, and two more for Victoria Buildings.

Two questions are very often asked by proprietors of elevators, namely:—

1st.—Will the attaching of the governor in any way damage our existing plant?

2nd.—Is not the cost of keeping the machine in repair likely to be very heavy?

The answer to the first is—The governor in no way damages any existing plant, because it works as a separate water engine, and the water circulating between the governor

and the existing elevator is kept well lubricated, thus virtually preserving the existing plant and causing less wear and tear.

The answer to the second question is—The fact that the Hydraulic Automatic Governor Company offer to keep the governor in order for about £5 per year, conditionally that a fair number of machines are fixed so as to fully employ the time of a mechanic inspecting them.

The small space occupied, take for example the cupboard under the stairs in the Victoria Buildings, makes it a matter of no difficulty to find a place for it in the buildings already erected.

The machine. although applicable to all classes of elevators working with various powers, is especially suitable for working the high pressure, and no doubt this will be the power for elevators for many years to come, on the grounds of its economy when the governor is used; cleanliness and freedom from danger of fire. Everything has been done to make the machine perfect in its working of high-pressure elevators.

There are several machines invented to give more than one power to the elevators, but in all cases these are dependent on the lift-driver opening the valve for the cylinder he considers necessary to do the work, thus leaving the water saved at the discretion of the lift-attendant, and, in the event of his judgment being defective, the saving would not be worth considering, and again, if he should be especially fond of very high speed, he would probably always open up the full power valve and thus save nothing.

The tendency of elevator proprietors, at present, is to cut down the carrying capacity of the elevator to save the water consumption. This is not a sound principle, as in a great many cases where this has been done two trips have to be done to do the work that should have been done with one, thus actually using more water in the end. Whereas, if the elevators are designed to carry the maximnm load likely to occur at one time, and the governor attached, they are then in a position to

carry any loads up to the maximum, and only use water in proportion to the weight carried.

The governor tells its own tale on the meters, all of which belong to the Hydraulic Power Company, and being automatic and registering its own record, nothing can affect its saving power, with the exception of a smaller number of passengers and trips being run with the machine attached, to those when the elevator runs under its old conditions.

To avoid this, in any test trials that are made, cards are given to the driver, who keeps a record of the number of the passengers carried, and the distance travelled with and without the governor, which in each case are resolved to a common factor. The quantity of water used being ascertained by meter readings at the same time, gives the necessary data to decide the actual saving effected by the use of the governor.

To get the greatest possible saving from the governor it is necessary that the existing plant should be in thorough order, and one of the most important points to be taken into consideration is the balancing of the cage, as in the event of the cage not being balanced, it simply means that so much weight has to be lifted by power-water when a counter balance would act as effectively. The balance of the cage should be perfect throughout every part of the full stroke, especially on high buildigs.

The Automatic Hydraulic Governor is designed and constructed on sound mechanical principles, and the working parts are simple and durable. It can be erected at a reasonable cost, and being a highly efficient economiser of power-water should come into general use in connection with hydraulic elevators.

APPENDIX.

PRACTICAL RESULTS OF ECONOMIC SAVING EFFECTED BY THE GOVERNOR.

WITHOUT THE GOVERNOR.					WITH THE GOVERNOR.		
Name of Building.	Name of Proprietor.	Maker of Lift.	Meter Reading.	Quantity used.	Meter Reading.	Quantity used.	Per cent. saved.
			Date. Hour.		Date. Hour.		
Melbourne Chambers	Lloyd Tayler, Esq.	T. Robinson and Son	May 3, 10.15 a.m., 415,550 May 10, 10.15 a.m., 421,120	5,570	May 10, 10.15 a.m., 421,120 May 17, 10.15 a.m., 423,830	2,710	51·3
Oxford Chambers	Victorian Finance Co., Ltd.	R. Waygood and Co.	April 1, 9.30 a.m., 168,080 April 8, 9.30 a.m., 187,400	19,320	Mar. 25, 9.30 a.m., 158,010 April 1, 9.30 a.m., 168,080	10,070	47·8
Victoria Buildings	The Freehold Banking Co., Ltd.	R. Waygood and Co.	June 28, 11 a.m., 247,040 June 30, 11 a.m., 252,300	5,260	*June 30, 11 a.m., 252,300 July 1, 11 a.m., 253,800	1,500	43
			Average for 24 hours	2,630			
City Bank Chambers	City of Melbourne Bank, Ltd.	Johns & Co.	Average daily consumption	1,400	Aug. 1, 9 a.m., 315,300 Aug. 2, 9 a.m., 315,920	620	55·7

* This record was made when the machine was first started (and everything new), the consumption per day is now 1,300 gallons = 50 per cent.

THE QUARTERLY RESULTS OF ECONOMIC SAVING EFFECTED BY THE GOVERNOR.

WITHOUT MACHINE.			WITH MACHINE.		
Melbourne Chambers, Quarter ending 30th December, 1890 ..	66,200	Quarter ending, 30th December, 1891 ..	29,200		
,, ,, ,, ,, 30th March, 1891 ..	60,500	,, ,, 30th March, 1892 ..	37,400		
		,, ,, 30th June, 1892 ..	34,740		
Oxford Chambers ,, ,, 30th December, 1891 ..	234,900	,, ,, 30th June, 1892 ..	131,340		