ing the ten minutes elapsing between the times of tripping, or at least that the mean velocity during that period has been the same as at the moment of tripping.

Nevertheless, its invention, design and perfection are the fruits of great ingenuity and of much knowledge and painstaking labor, and they have been of vast benefit to the community by making, of the Venturi meter, a practical working tool.

Its inventors, Messrs. Frederick N. Connet and Walter W. Jackson, of Providence, R. I., are therefore entitled to distinguished honor at the hands of the Franklin Institute, and we take pleasure in recommending the award, to them, of the John Scott Legacy Premium and medal for their Registering apparatus.

Adopted at the special meeting of the Committee on Science and the Arts, held Wednesday, June 22, 1898.

JOHN BIRKINBINE, *President.*

WM. H. WAHL, *Secretary.*

Countersigned by

JAMES CHRISTIE,

Chairman Committee on Science and the Arts.

[The sub-committee which conducted this investigation was composed of Messrs. J. C. Trautwine, Jr., chairman, John E. Codman and Rudolph Hering.]

THE HYATT ROLLER BEARING.

[*Being the report of the Franklin Institute, through its Committee on Science and the Arts, on the invention of J. W. Hyatt, of Harrison, N. J.*]

[No. 1880.] HALL OF THE FRANKLIN INSTITUTE,

PHILADELPHIA, June 22, 1898.

The Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, acting through its Committee on Science and the Arts, investigating the merits of Hyatt's Roller Bearings, reports as follows:

The utility of anti-friction rollers is well known among mechanics, and they have been very extensively employed

on many classes of machinery. Their advantages and the obstacles sometimes encountered in their use are so well known that it is unnecessary to enter into an explanation of the subject.

The sole innovation presented by the rollers of J. W. Hyatt, is the employment of an elastic, spirally-wound tubular roller, instead of the solid cylinder hitherto used. The mode of supporting the rollers, and the frames for confining them, are essentially identical with those long in use with the solid rollers.

The Hyatt roller, in appearance, resembles a closely wound spiral spring, made from a strip of steel of a rec-

Hyatt spiral roller bearing.

tangular section, and the roller consequently has all the flexibility of a similar spring.

An experience of many years with anti-friction rollers by a member of this committee, and under many diverse conditions, justifies the assertion that one of the principal causes of failure on the part of anti-friction rollers which have been accurately made and well mounted, is due to an unequal distribution of pressure on the face of the rollers, causing distortion in detail or gradual destruction of the rollers. This inequality of pressure may be due to slight deflection of shafts, or yielding of supporting surfaces, or the axes of rollers and shafts may not be exactly parallel;

in fact, many different causes frequently act to prevent that perfect distribution of pressure over the whole length of the roller, which is essential to its longevity.

The pressure that rollers will safely endure depends on the diameter of the roller, on the hardness of the material in the rollers and of the surface they bear on, and also on the rapidity of the motion.

The endurance and frictional resistances of rollers under varying conditions of dimensions—material and speed—have been the subject of considerable experiment, which it is not necessary to quote further, as in this investigation the only question under consideration is the relative merits of the solid and the spiral formed roller.

In order to obtain experimental information on the subject, a series of experiments was made under several condi-

tions, and the result of these experiments, which involved considerable time in the execution, are condensed into the attached table. Four of the Hyatt spiral rollers, and four solid steel rollers, all uniformly $\frac{3}{4}$ inch diameter and 10 inches long, were used in the tests. The Hyatt rollers were formed of strips of steel $\frac{1}{2}$ inch wide and $\frac{1}{8}$ inch thick, and were apparently of spring-steel, although we are informed that a softer grade of steel is used. The solid rollers were of a softer grade of steel, about 70,000 pounds tensile strength. The harder material in the spiral roller rendered it less liable to abrasion, but would not affect the resistance to rolling, so long as no abrasion occurred. These rollers were placed between three plates, as shown in sketch, and the whole set placed between the plates of a testing machine,

and vertical pressure applied. Whilst under this pressure a horizontal force was applied to the plate *B*, and the resistance to rolling accurately measured by its reaction on the platform of a scales. The faces of the plates *A* and *a* were planed, and in one series of experiments both faces of plate *B*. In the other series both faces of plate *B* were rough, that is, as they left the rolling mill. Increasing vertical pressures were applied, up to a maximum of 550 pounds per lineal inch of roller, when the apparatus employed would not permit a higher pressure, owing to the resistance to motion of the plate *B* when solid rollers were employed, but under the same conditions with the spiral rollers, it was possible to place a pressure per lineal inch of 700 pounds.

Hyatt spiral roller bearing applied to ball and socket pillow blocks with steel boxes.

As the experiments were all made between the rigid plates of a machine in which the pressure was applied by screws, and registered on a scale beam, it was suspected that this rigidity might be more favorable to the spiral than to the solid roller. Therefore, an experiment was made in which the pressure was applied by a weight acting on a lever, and due to gravity only, with the following result:

Total Pressure Applied.	Resistance to motion of Plate B.	
	With Spiral Rollers.	With Solid Rollers.
2,000 pounds.	9 pounds.	26 pounds.
3,000 pounds.	17 pounds.	34 pounds.

These results correspond closely to the first experiments, and prove that the manner of applying pressure was not the cause of the difference in resistance to rolling.

It will be observed by the table that the resistance to motion was much less with the spiral than with the solid roller under all the pressures employed, both with the smooth and the rough center plate.

This reduction of rolling resistance varied from 10 to 66 per cent., and averaged 51 per cent. less with the smooth center plate, and 23 per cent. less with the rough center

Hyatt spiral roller bearing applied to post hanger.

plate. Observations were likewise made to ascertain the thoroughness of the bearing contact between the plates and the rollers. With the rough center plate the incomplete bearing of the solid roller was plainly discernible, and under the maximum pressure employed, the solid roller showed indications of grooving at the point of contact, which is the usual manner of failure of anti-friction rollers. On the con-

trary, under the same conditions, the spiral rollers showed a complete bearing throughout their entire length, the elasticity of the roller permitting it to follow the sinuosities of the rough plate and maintain contact.

The pressures employed in the experiment were about as high as good practice tolerates with the slowest motion, and very much higher than is permissible with the velocities usual in ordinary shafting.

The spiral rollers are now regularly manufactured and successfully applied in practical use. The high pressure borne by the spiral roller without permanent deformation, its low resistance to motion as compared to the solid roller, and its elastic adaptation to inequalities of surface, were clearly exhibited by the experiments.

The Franklin Institute recommends the award to John W. Hyatt of the John Scott Legacy Premium and Medal, for his invention of the elastic spiral anti-friction roller.

Adopted at the special meeting of the Committee on Science and the Arts, held Wednesday, June 22, 1898.

JOHN BIRKINBINE, *President.*

WM. H. WAHL, *Secretary.*

L. F. RONDINELLA,

Chairman Committee on Science and the Arts.

[The sub-committee which conducted this investigation was composed of James Christie, chairman, Hugo Bilgram, Spencer Fullerton, J. Sellers Bancroft, H. W. Spangler.]

APPENDIX.

COMPARISON OF SPIRAL AND SOLID ROLLERS.

TABLE NO. 1.

Total Pressure on Rollers. Pounds.	Pressure per linear inch of roll. Pounds.	Planed Plates.			Rough Plates (rolled).		
		Spiral Roller Coef. of Friction.	Solid Roller Coef. of Friction.	Ratio of Cols. 3 to 4 per cent.	Spiral Roller Coef. of Friction.	Solid Roller Coef. of Friction.	Ratio of Cols. 6 to 7 Per cent.
1	2	3	4	5	6	7	8
1000	28	'005	'013	38	'018	'030	60
2000	55	'0055	'0125	44	'019	'026	73
3000	83	'005	'0116	43	'019	'021	90
4000	111	'0045	'012	38	'017	'021	81
5000	138	'004	'0116	34	'015	'022	68
6000	166	'0045	'0117	38	'016	'022	73
8000	221	'0056	'010	56	'017	'024	71
10000	277	'0063	'0113	56	'023	'026	88
12000	332	'0082	'018	46	'021	'028	75
14000	387	'012	'0195	61	'020	'029	69
16000	442	'014	'021	67	'024	'029	83
18000	498	'015	'024	62	'025	'029	86
20000	554	'016	'032	50	'029	'035	83
22000	609	'020			'031		
24000	664	'025			'033		
25000	700	'029			'034		

Percentage of coefs. of rolling friction of Spiral Rollers to Solid Rollers :

Plates Planed.	Plates Rough.
Least 34 per cent.	Least 60 per cent.
Greatest 67 per cent.	Greatest 90 per cent.
Average 48.7 per cent.	Average 77 per cent.

TEST OF HYATT SPIRAL AND SOLID STEEL ROLLERS.

TABLE II.

Total Pressure on Rollers in Pounds.	Pressure per Lineal Inch of Rollers in Pounds.	ALL PLATES PLANED.			
		"Hyatt" Spiral Roller.		Solid Roller.	
		Pounds to Move Plate "B."	Coeff. of Friction.	Pounds to Move Plate "B."	Coeff. of Friction.
1,000	28	5	'005	13	'013
2,000	55	11	'0055	25	'0125
3,000	83	15	'005	35	'0116
4,000	111	18	'0045	43	'012
5,000	138	20	'004	58	'0116
6,000	166	27	'0045	70	'0117
8,000	221	45	'0056	83	'010
10,000	277	63	'0063	113	'0113
12,000	332	98	'0082	213	'018
14,000	387	168	'012	273	'019
16,000	442	220	'014	334	'021
18,000	498	273	'015	438	'024
20,000	554	323	'016	638	'032
22,000	609	458	'020	Not Obtainable.	
24,000	664	555	'025		
25,200	700	739	'029		

PLATE "B." A ROLLED PLATE NOT PLANED.				Spiral Roller Deflection.	REMARKS.
"Hyatt" Spiral Roller.		Solid Roller.			
Pounds to Move Plate "B."	Coeff. of Friction.	Pounds to Move Plate "B."	Coeff. of Friction.		
18	'018	30	'030	'002	The "Deflection" means the flattening or reduction of vertical diameter of the spiral roller.
38	'019	53	'026	'003	
58	'019	63	'021	'004	
73	'015	110	'022	'0055	
99	'016	134	'022	'0055	
138	'017	194	'024	'006	
228	'023	260	'026	'006	
260	'022	338	'028	'006	
293	'021	412	'029	'006	
378	'024	463	'029	'006	
458	'025	518	'029	'006	
578	'029	708	'035	'006	
698	'031	Not Obtainable.		'006	
808	'033			'006	
878	'034			'006	