THE WESTINGHOUSE FRICTION DRAFT GEAR

BVILT BY

THE WESTINGHOUSE AIR BRAKE CO
PITTSBURGH, PA., U.S.A.

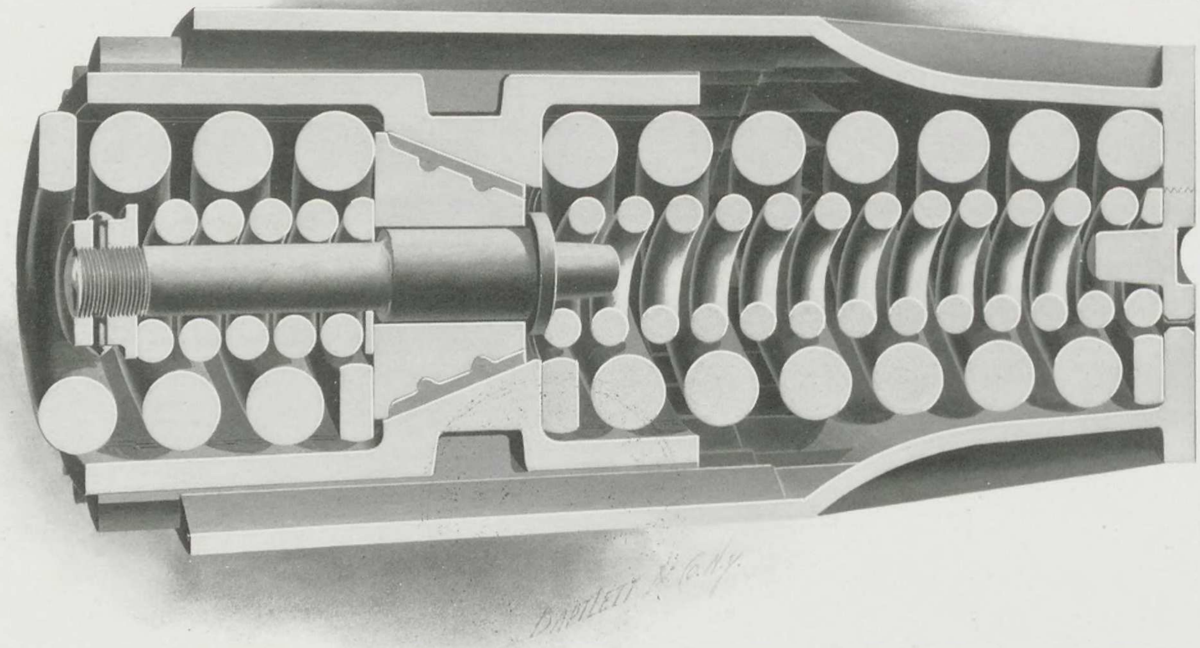
Sammenslutning af elektriske Selskaber

New York, 1 Januar. „New York Herald" meddeler: Piermont Morgan har foreslaaet en Sammenslutning af „Westinghouse Electric and Manufacturing Company" i Pittsburg med „General Electric Company". Det nye Selskab skulde have en Kapital af henved 50 Millioner Dollars. Selskaberne har Filialer i England, Frankrig og Tyskland, der ligeledes eventuelt skal gaa over til det nye Foreta-

625.201 Jern

(Eske)

Plate I.



Longitudinal Section of the Westinghouse Friction Draft Gear

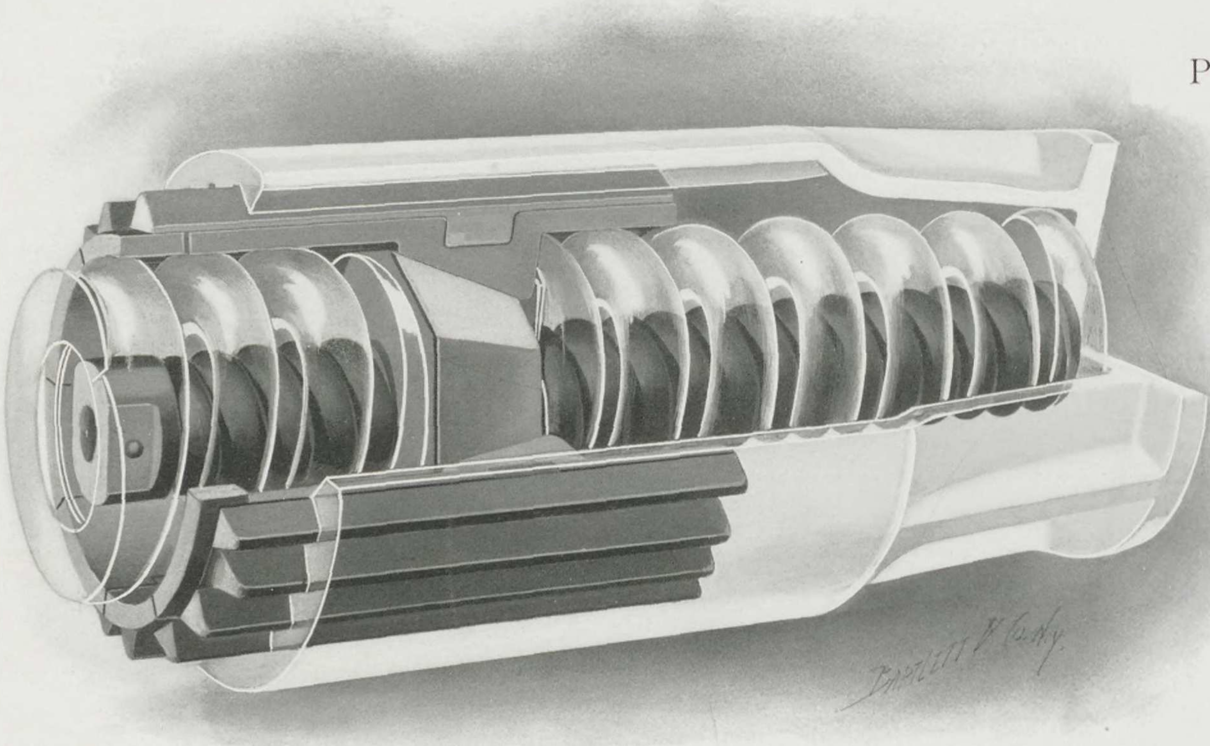
The Westinghouse Friction Draft Gear Built by The Westinghouse Air Brake Co., Pittsburgh, Pennsylvania, U. S. A.

1900.

Bartlett & Company
The Orr Press
New York

List of illustrations showing various views of the Westinghouse Friction Draft Gear, with applications to different forms of car and locomotive tender frames.

Plate II.



Transparent Interior View of the Westinghouse Friction Draft Gear

Announcement

THE attention of the Westinghouse Air Brake Company, in the introduction of air brakes, first upon passenger and later upon freight trains, was called to the necessity for modification and improvement in the draft-gear apparatus commonly used, and the problems involved have thus demanded and received constant study from its officials, especially Mr. George Westinghouse, to whom have been issued numerous patents covering a practical solution of such problems. The Company has, therefore, undertaken to manufacture and introduce the Friction Draft Gear apparatus covered by those patents, and has established a special department for that purpose under competent management.

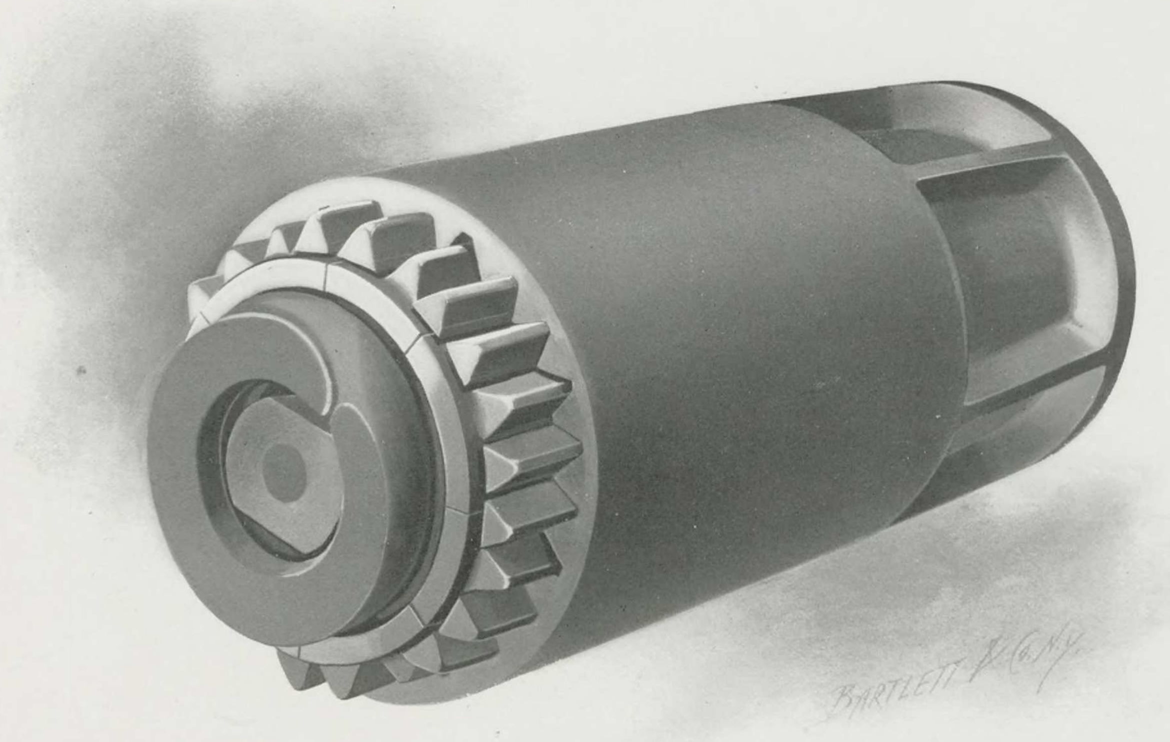
This apparatus is of special value when applied to freight and passenger locomotives and also to passenger cars, and its use is essential to the ultimate successful operation of long trains of freight cars, particularly those of steel construction, on account of their extreme rigidity, which makes the use of the Frictional Draft Gear doubly important. It is also believed that when its merits are fully understood the economies resulting from its use will lead to its general application to all classes of rolling stock.

It is worthy of note that a considerable benefit results from the use of the Friction Draft Gear upon the tender, or even one car only in a train, so that its introduction may be undertaken gradually.

The Westinghouse Air Brake Company

June 1st, 1900. Pittsburgh, Pa.

Plate III.



Exterior Perspective View of the Westinghouse Friction Draft Gear

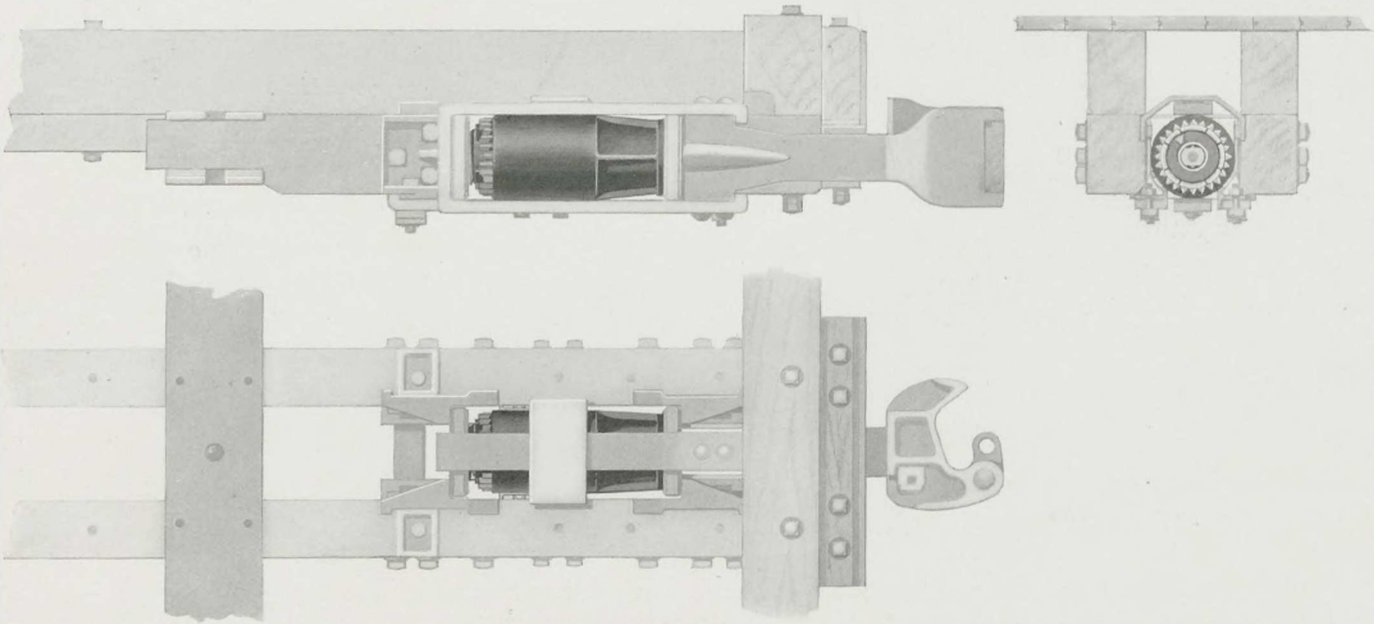
Friction Draft Gear

THE inadequate and unsatisfactory character of existing draft-gear arrangements, resulting in frequent accidents and interruptions to traffic, with their attendant heavy costs, are too well known and appreciated by railway managers to require extended comment. The difficulties surrounding this feature of railway construction and operation are illustrated by the fact that although many other details of locomotive and car construction have been standardized, yet—after half a century of effort, involving thousands of changes in form and detail—no draft gear has, until now, been produced having sufficient merit to justify its general adoption as a standard. The difficulties due to weak draft gear have been enormously increased during the past few years, not only on account of the employment of heavy cars of both wood and steel construction in trains of great weight, but also by reason of the greater power of the locomotives required to move these trains.

The following points are in illustration of the power and force problems involved, and of the difficulties to be overcome:

First.—The normal maximum direct draw-bar pull of a locomotive is about 25 per cent. of the weight of the driving wheels upon the rails, and, according to the weight of the locomotives in use, varies from 18,000 to 55,000 pounds.

Plate IV.



Application of the Westinghouse Friction Draft Gear to Freight Cars and Locomotive Tenders with Wooden Sills

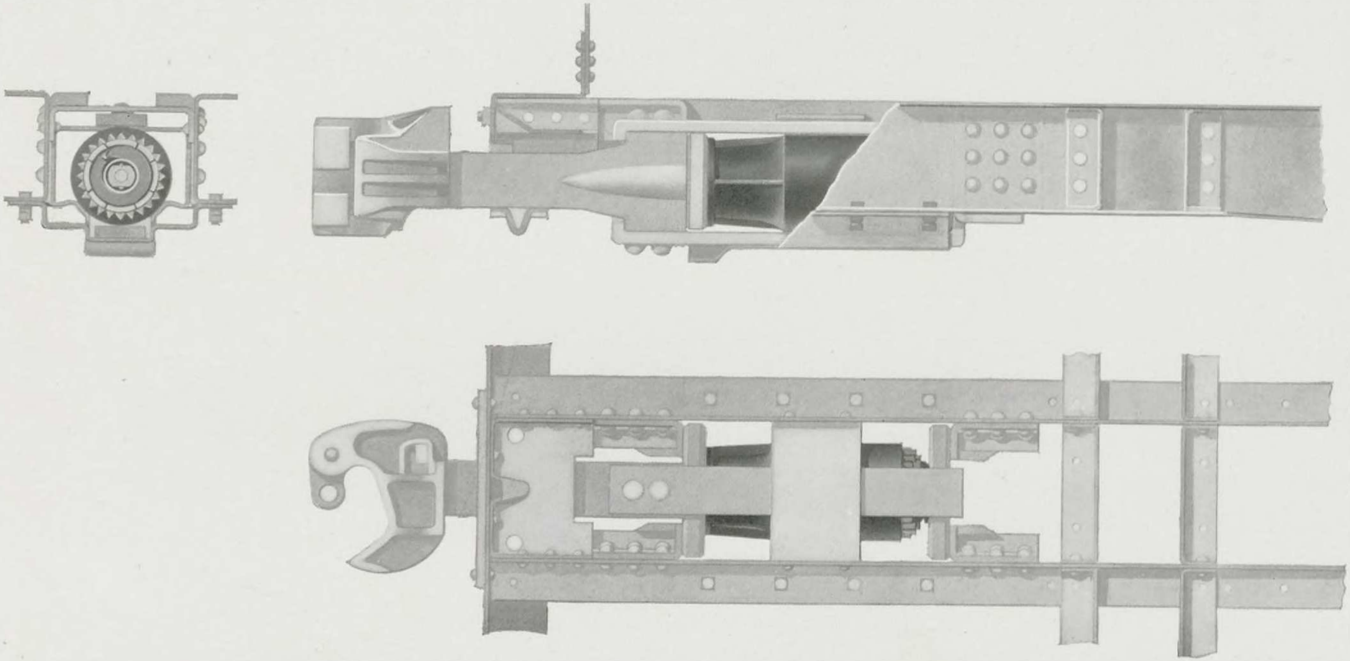
Second.—If a locomotive, when attached to a train, be suddenly moved, its draw-bar pull or buffing impact will be enormously increased above its normal effort, depending upon the amount of slack motion between the engine and car or cars.

Third.—The draft springs in use upon nearly all of the cars in the United States have each a motion of 1¾ inches, and a maximum resistance of 20,000 pounds, which is capable of absorbing less than 10 per cent. of the force frequently exerted in draft or buffing operations.

Fourth.—Any force applied to a draw-bar in excess of that absorbed by the draft spring delivers a blow to the draft-gear attachment and car framing the result of which can best be appreciated by considering the effect which would be produced by replacing draft springs with solid pieces of metal of the length of the draft springs when compressed, creating thereby at each end of a car a lost motion of 1¾ inches. In such a case a movement of the locomotive in either direction would, through the draw-bars, deliver hammer blows on the draft-gear attachments which, in many instances, would be only 10 per cent. greater than the blow resulting were the draft springs in operation.

Fifth.—To avoid the breakage of couplings and draft-gear attachments and injuries to car bodies there should be used, in place of the present draft springs, yielding resistances *capable of absorbing and dissipating* any force due to coupling, switching, brake applications, or stresses exerted by the locomotive in starting trains; and experience has shown that yielding *frictional*

Plate V.



Application of the Westinghouse Friction Draft Gear to Freight Cars of the Pressed Steel Type resistances, having a maximum capacity of 140,000 pounds, are entirely effective in the prevention of blows and shocks.

Sixth.—A spring stores, but does not *dissipate*, the force applied to it, so that when compressed in any train operation it is instantly ready to exert its full power in the opposite direction, thereby greatly increasing the strains tending to break or damage the draw-bars or attachments.

The frictional apparatus described and illustrated in this pamphlet is the result of fourteen years of study and experiment involving large expenditures. It has been in use for five years in daily service upon passenger cars, steel cars and heavy coke cars, there being at the present time a total of 3090 cars and 115 locomotives equipped.

From its construction it will be seen that as a whole it occupies the same relation in regard to draw-bars and attachments as does the ordinary draft spring. It, however, permits of a total movement of the draw-bar in either direction of 2¼ inches, but requires a force of 140,000 pounds to complete its stroke. The resistance through one-fourth of this 2¼-inch motion is due to an ordinary spiral spring, which provides the requisite elasticity for ordinary operations; the balance combines a friction resistance with spring pressure that dissipates the effect of heavy strains or blows. Although a force of 140,000 pounds is required to fully compress the friction apparatus, yet its reactive effect is less than 6000 pounds.

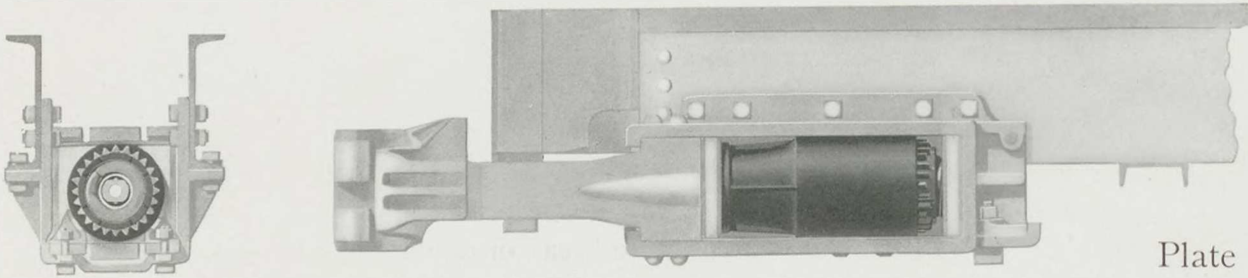
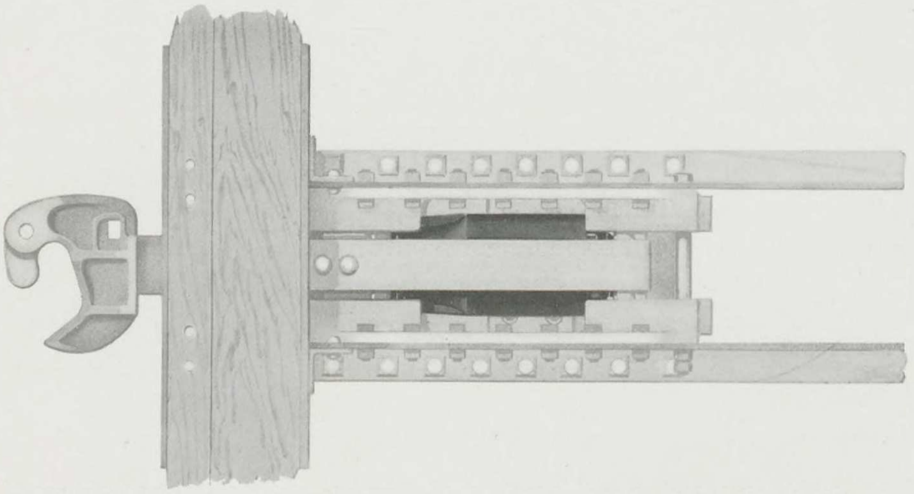


Plate VI.



Application of the Westinghouse Friction Draft Gear to Locomotive Tenders with Metal Center Sills

Every railway manager is aware of the difficulty in starting long trains drawn by heavy locomotives without injury to draft gear. With our device no shock is possible, as an important object in the construction of the Westinghouse Draft Gear has been to provide a resistance *greater* than the tractive effort of two of the heaviest locomotives that may be employed for hauling long trains, and this has been successfully accomplished.

Steel Car Train Experiments

THE following record of tests of this apparatus will be more interesting and important to the majority of railway managers, than the full technical description, which is also printed herewith :

Experiments to test the operation of the Westinghouse Friction Draft Gear were made upon a train of thirty-five steel cars, loaded with fifty tons of ore each, and drawn by a locomotive capable of exerting a draw-bar pull of 40,000 pounds. Two private cars were attached to the rear of the train.

First Experiment: The engine and twelve cars were detached from the balance of the train and then returned and coupled at a speed of five miles per hour. The resistance of the draft gear was not exhausted.

Train of Steel Cars Equipped with t

Second Experiment: The first experiment was repeated, but at a speed of eight miles per hour, the force in this case equalling or slightly exceeding the resistance of the draft apparatus. In neither case were there any breakages or objectionable shocks or reactions.

Third Experiment: An emergency stop was made from a speed of twenty-five miles per hour with the brakes acting upon the first eighteen cars, those upon the remaining cars being cut out. There were no shocks or disturbances of any kind in the rear cars or in any other portion of the train, and at no point was the frictional resistance completely exhausted.

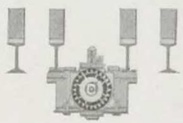
Repeated stops were made with the brakes acting upon different proportions of the train, always with equally good results. Owing to the extreme weight of the train, the locomotive was invariably obliged in starting to take slack and move ahead with maximum effort, and in no case was there any shock or breakage resulting from such effort.

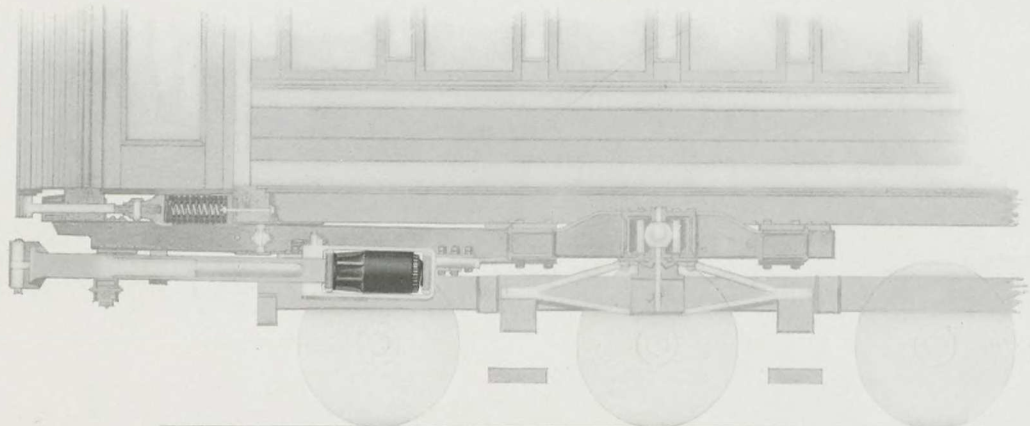
e Westinghouse Friction Draft Gear

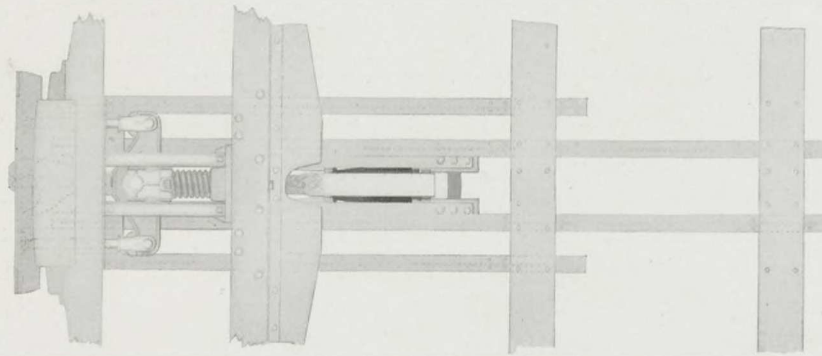
Operation of Apparatus on a 45-car Coke Train in Daily Use for Four Years

NEARLY all of the important experiments in the development of the Friction Draft Gear have been made upon this train, which is drawn by two engines and has been in daily service for four years. Since the substitution of yokes for tail bolts there have been no breakages of the Friction Draft Gear, notwithstanding the fact that it has made double the mileage of other trains fitted with ordinary draft gear in similar service. In the operation of this train between the coke regions and the point of delivery it is necessary to weigh each car, and this is accomplished in the following manner, *viz:* The engine is detached from the train and run from 100 to 200 feet beyond the weigh scale. The cars are then separately detached, weighed

Plate VII.



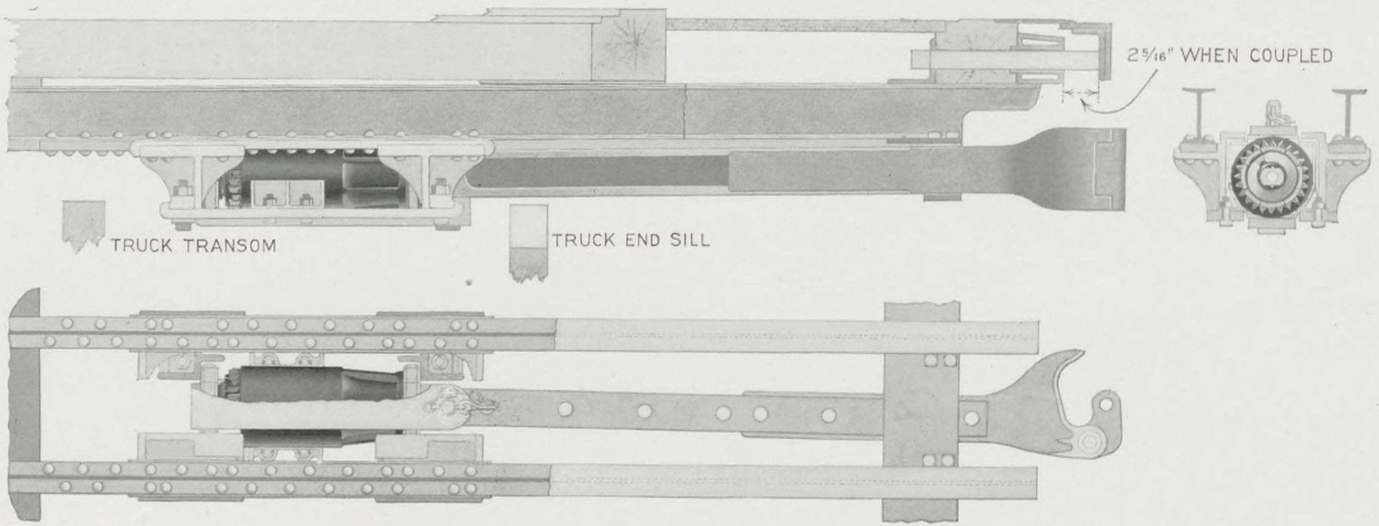




Application of the Westinghouse Friction Draft Gear to Cars Equipped with the Standard Steel Platforms while in motion, coupled by impact and again formed into a train. The entire operation of uncoupling, weighing and coupling for the forty-five cars is accomplished in fifteen minutes, necessarily involving rapid and severe handling, which is very destructive to the ordinary type of draft gear. The service requires the train to be frequently stopped or slowed, but when required to proceed the engineer never hesitates to apply steam to the locomotive while the train is yet in motion and before the brakes are entirely released. A like practice with trains equipped with the ordinary draft gear would invariably result in a "break-in-two."

To further demonstrate the ability of this device to prevent the parting of trains, the brakes on the front portion of the train were cut out and those on the remaining cars applied in emergency when the train was moving at a speed of about twenty miles per hour. Even under this most severe test it was impossible to part the train, nor was there any noticeable shock or surge on the front portion of the train. With the usual draft appliances such a test would result disastrously. Frequent attempts have been made by engineers, upon request, to break the train in two by first taking slack and then moving forward with full power. In no instance has such an attempt been successful.

Plate VIII.

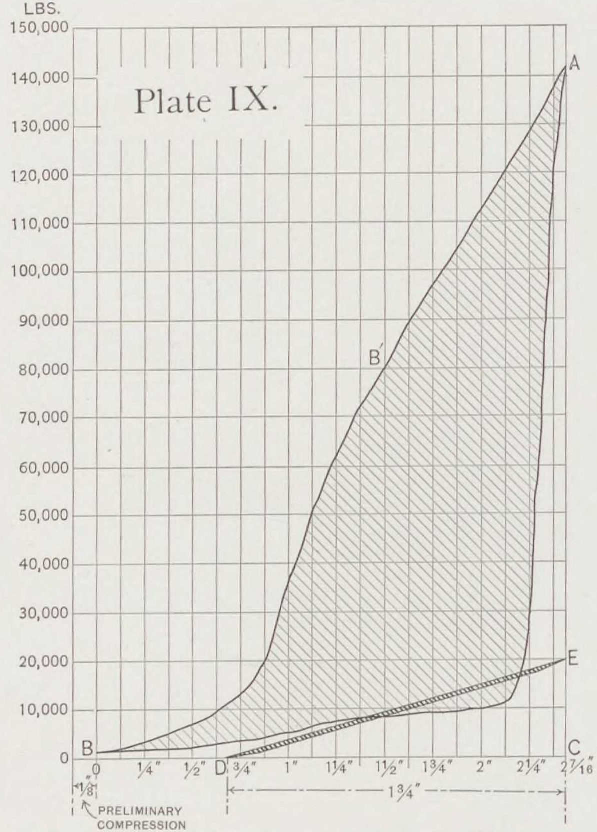


Application of the Westinghouse Friction Draft Gear to Cars Equipped with the Standard Steel Platforms

Freight Engine Service

ALL of the locomotives of the Union Railroad (the Pittsburg terminal of the Pittsburg, Bessemer & Lake Erie Railroad) are fitted with this apparatus, two of these locomotives having a total weight of 167 tons each, with 200,000 pounds upon the driving wheels with a draw-bar pull of 50,000 pounds. Before the frictional apparatus was applied, repairs to draft gear were required about every ten weeks, the cost thereof averaging 83 cents per thousand miles, without allowance for the time the engines were out of service. The Friction Draft Gear has now been in operation about fifteen months upon the two heavy engines and during that time no repairs to the draft gear have been required.

This apparatus has been in constant use upon the Pullman private car "Glen Eyre" for three years with the most satisfactory results, there having been none of the inconvenient and disagreeable shocks when switching which were of daily occurrence prior to its application.



This diagram shows the Relative Capacities of the Ordinary Draft Spring (20,000 Pounds Capacity) and the Westinghouse Friction Draft Gear to Absorb and Dissipate Buffing and Pulling Effects. It also shows the Reactive Effects of Each.

The rising line, *BB′A*, represents the action of the Westinghouse gear under pulling or buffing stress, starting at an initial compression of about 2000 pounds, as shown at the left of the diagram, and rising to a maximum stress of 142,000 pounds. The total area, *BACB*, represents the work done in arresting the buffing or pulling stress, while the lightly shaded area represents the amount of energy dissipated as heat by the frictional gear. The shaded portion is in this instance found to be 80 per cent. of the total area, *BACB*, only 20 per cent. of the energy of impact being given back in recoil as shown by the non-shaded portion of the area *BACB*.

The straight line *DE* represents the operation of an ordinary spring gear starting from zero compression. The area *DEC* represents the work done upon the spring during compression, and the narrow, heavily shaded area *DE* represents the amount of energy dissipated in frictional heating by the spring. In this instance the proportion of energy dissipated is only 7 per cent., as against 80 per cent. of the total energy in the case of the Westinghouse gear.

The diagram also shows in a very striking manner the maximum capacities of the two types of gear, the ordinary gear being shown at its maximum of 20,000 pounds, while the capacity of the Westinghouse gear is not exhausted until a compression of 140,000 pounds and over has been reached.

Description

A VIEW of the complete draft gear is shown in Plate X., Fig. 1, and the relations of the parts to the under frame of the car are shown on Plates IV., V., VI., VII. and VIII. The frictional device is placed within the yoke and between the followers in the usual manner. To accommodate the increased diameter the yoke is widened, and when attached to the standard M. C. B. coupler, filling pieces are used, as shown in Fig. 15. A coupler with the back end built up as shown in Fig. 1, however, makes a simpler and cheaper arrangement. The inner follower plate, *A*, receives the pulling stresses from the yoke end; the outer follower transmits them to the draw-bar stops and to the car framing. In the common form of draft gear the spring resistance is interposed between the follower plates; that is, the pulling and buffing stresses tend to reduce the distance between the follower plates, and these stresses are resisted by the springs which tend to hold the follower plates apart. This Friction Draft Gear acts precisely in the same way, but the resistance of springs is supplemented by vastly greater frictional resistances both in pulling and buffing.

Bearing against the follower plate, *A*, is a spring, *C*, the other end of which bears against a wedge, *D*, made in the form of a frustum of an octagonal pyramid with hard brass facets, as shown in Fig. 1.

Surrounding the wedge are four pairs of malleable-iron segmental carriers, *E*, having inclined bearing surfaces, *N*, of the same angle as the wedge, as shown in Figs. 2, 3, 4, 5 and 6. These

Plate X.

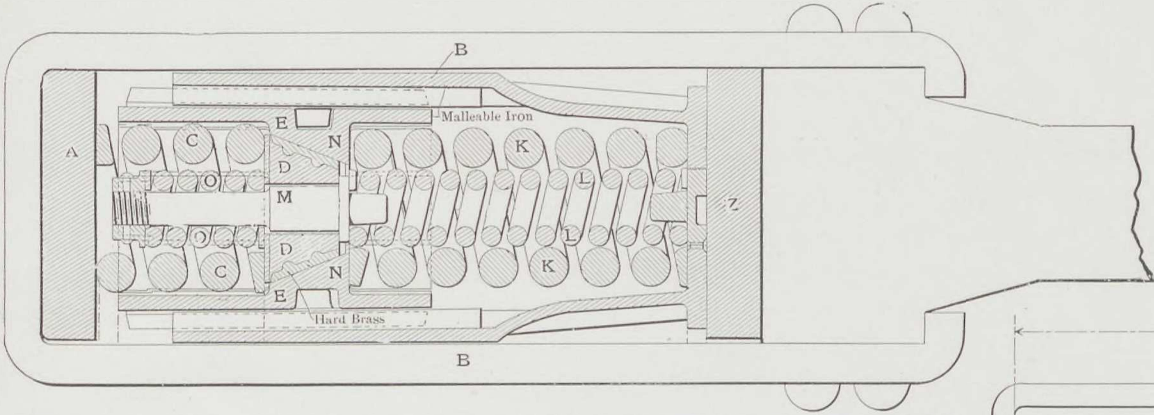


Fig. 1

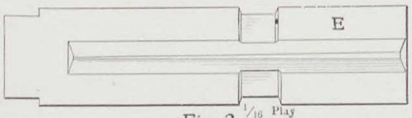


Fig. 2

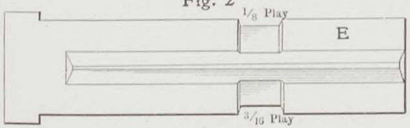


Fig. 3

Fig. 4

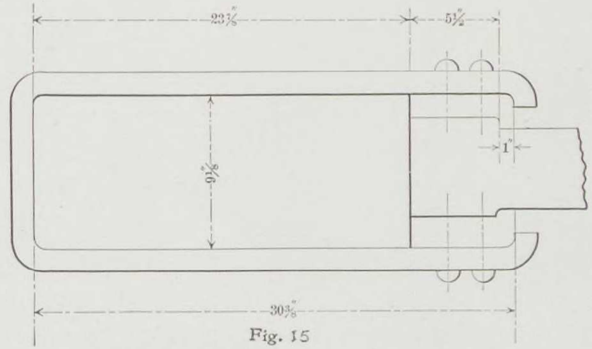


Fig. 15

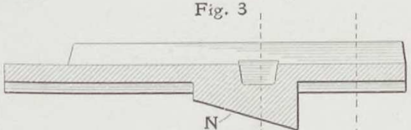


Fig. 5

Fig. 6

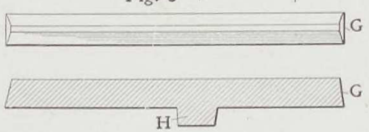


Fig. 7

Fig. 8

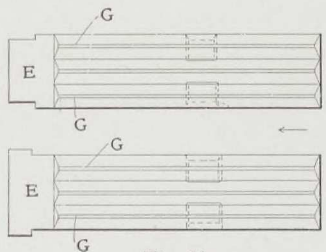


Fig. 10

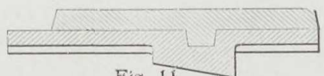


Fig. 11

Fig. 12

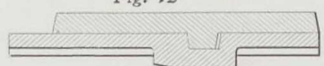


Fig. 13

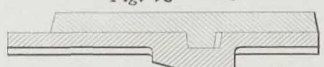


Fig. 14

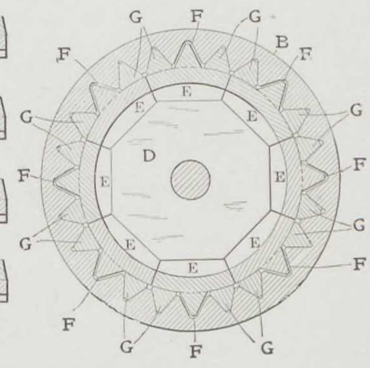


Fig. 9

segmental carriers, *E*, have a central longitudinal rib cast upon them to strengthen and guide them. These ribs fit the grooves, *F*, in Fig. 9, loosely.

The other grooves of the frictional cylinder, Fig. 9, are filled by the hardened wedge bars, *G*, Fig. 7. The shape of these wedge bars is seen in Figs. 7 and 8. They rest upon the segmental carriers, *E*, as shown in the sectional views of Figs. 11 to 14, with the small inwardly projecting portions, marked *H* in the lower view of Fig 7, engaging cavities in the carriers, *E*, so that if the carriers, *E*, are moved longitudinally to the right or left the wedge bars, *G*, must move with them.

The function of the preliminary spring, *C*, Fig. 1, is to force the wedge against the inclined surfaces, *N*, of the segmental carriers, and also to absorb the ordinary pressure on the draw-bar due to the movement of the train. When the apparatus is placed in the yoke this spring is under a slight compression, which insures the parts being held tightly in position, thus preventing foreign substances from lodging between the bearing surfaces. The auxiliary preliminary spring, *O*, Fig. 1, gives additional pressure on the wedge. The main release spring, *K*, is used for returning the segmental carriers and wedge bars to their normal position after the force to close them has been removed, and it also gives additional capacity to the device. The function of the auxiliary spring, *L*, is to release the wedge, *D* ; and the release pin, *M*, relieves the pressure of the auxiliary spring, *L*, against the wedge during frictional operation.

Operation

WHEN, either in draft or in buffing, the stress upon the draw-bar moves the follower plates, *A* or *Z*, Fig. 1, toward each other, the preliminary spring, *C*, is compressed, and if the pressure so applied is less than is required to force the follower plate, *A*, against the release pin, *M*, the segmental carriers and wedge bars remain at rest. The capacity of this spring is about 20,000 pounds and is sufficient to provide for a large percentage of the draw-bar movements, thus greatly relieving the frictional element from motion and consequent wear. When, however, the stress exceeds the capacity of the preliminary spring sufficiently to push the follower, *A*, against the ends of the segmental carriers, it will have forced the release pin, *M*, which projects slightly above the segmental carriers, toward the closed end of the cylinder, thereby relieving the pressure of the auxiliary release spring against the small end of the wedge. In this position the force necessary to compress the springs, *C* and *O*, is exerted against the large end of the wedge, and by the inclined surfaces it is transmitted through the segmental carriers to the wedge bars. A further increase of force against the follower plate, *A*, puts the segmental carriers and wedge bars into motion, and in so doing the force exerted by the wedge upon the wedge bars produces friction between the wedge bars and the V-shaped grooves of the cylinder (which is tapered toward the closed end). The traverse of the wedge bars is completed when the follower, *A*, comes in contact with the end of the cylinder, the release springs, *K* and *L*, having been compressed to about 80 per cent. of their capacity. The complete movement of both spring and frictional elements results in a total resistance of about 140,000 pounds.

On the removal of the pulling stress at the coupler, the springs, *C* and *O*, are restored gradually to their normal length. The preliminary release spring, *L*, then pushes the wedge back and away from the segmental carriers, and in this condition the main release spring, *K*, bearing upon the projections, *N*, of the segmental carriers, presses them to the left, which, when accomplished, withdraws all of the wedge bars from their positions in the grooves at the small end of the cylinder, constituting a complete release of the friction device.

The carriers, *E*, are arranged in pairs with interlocking outer ends, as shown in Figs. 2 and 3, in order to prevent them from being put together in wrong order. Each carrier contains two of the loose wedge bars, and the slots in the carriers in which the lugs of the wedge bars engage are of different lengths. In a set of two bars the first lug fits the slot, the second has $\frac{1}{16}$ of an inch play, the third $\frac{1}{8}$ of an inch play, and the fourth $\frac{3}{16}$ of an inch play, as indicated in Figs. 2 and 3. This is also clearly shown in the four sectional sketches, Figs. 11 to 14. If this is understood it will be clear that under the influence of the spring, *K*, the top wedge bar, Fig. 11, will be released first, and the others in succession as the space in the slots is taken up. Four bars are represented by Fig. 11, and when these are released the spring, *K*, releases four more represented by Fig. 12, and so on. Since there are eight carriers in all, or four sets of two each, it is only necessary for the spring, *K*, to release the wedge bars four at a time until all are free.

The operation of buffing is exactly similar to that of pulling, in that the follower plates are moved towards each other, but of course the load comes first upon the outer follower in this case. The application of the spring and friction resistances and the manner of fractional release are the same for pulling and buffing.

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