GRADUATES' ASSOCIATION.

AUTOMATIC COUPLERS.*

By Mr. FREDERICK C. HIBBERD, *Graduate*, of Manchester.

The subject of Automatic Couplers is important for all connected with the working of railways, the question of their adoption having been of late years the cause of a considerable amount of agitation in this and other countries. It is, however, an extremely wide one, and it will be impossible in this short Paper to do more than touch upon the most important points, namely :—

(1) The history of the automatic coupler question.
(2) The various systems of automatic couplers in use, with brief descriptions of typical examples of each system.
(3) The requirements of an ideal automatic coupler.
(4) The question of the adoption of the automatic coupler in Great Britain.

History.—In 1874 the Master Car-Builders' Association, a subsidiary association of technical men representing the various railways in the United States, turned their attention to the subject of an efficient automatic coupler, that is, one which would couple by impact. Various Committees were appointed, but it was not until 1884 that the Massachusetts Legislature passed an Act requiring that "as freight cars were constructed or purchased, or when cars were repaired, they should be fitted with such form or forms of automatic or other safety couplers as the Board of Railroad Commissioners may

* This Paper, read on 12th January 1903, has been selected by the Council for publication.

prescribe after examination and test of the same, to take full effect after 1st March 1885." In 1884 the Commissioners prescribed certain forms of couplers, of which 5,000 had been applied in 1888. Meanwhile the Master Car-Builders' Association in 1886 and 1887 undertook a series of competitive tests, and as the result of these tests they recommended a standard type known as the "Janney" coupler, a description of which will be found on page 904. It is important to notice that it was not the Janney coupler that was adopted, but one of the Janney type. The Master Car-Builders' Association, in fact, fixed what was known as the "Contour Line," Fig. 1, Plate 41, and determined the principal dimensions, Fig. 2, which had to be followed by all automatic couplers. They left the railway companies and inventors to fix the form and method of hinging the knuckle and the arrangement of the locking device. The outcome of this was that in 1891 a convention of the State Railroad Commissioners resolved that the States Legislature should require freight-cars to be equipped with automatic couplers of the Master Car-Builders' type.

Later, in 1893, the United States Congress passed an Act dealing, amongst other things, with automatic couplers, which says, "That on and after the 1st day of January 1898, it shall be unlawful for any such common carrier to haul or permit to be hauled or used on its line any car used in the inter-State traffic not equipped with couplers coupling automatically by impact, and which can be uncoupled without the necessity of men going between the ends of the cars. At the end of the period allowed, however, a large number of companies applied for an extension of time and were allowed a further two years, so that from January, 1900, all cars in the United States were to have been fitted with automatic couplers.

The progress of the automatic coupler in the United States of America (up to July 1898), as a result of this legislation, can be seen from the Table on page 901.

It will be noted that this Act of 1893 did not, like the Massachusetts Legislature, specify the particular form of coupler, but left it to the companies to decide upon one which would be suitable to the requirements of their traffic.

Date.	Total No. of Cars reported.	Fitted with Automatic Couplers.	Percentage.
1st January 1897 . .	1,054,815	517,617 .	49·1
1st July 1897 . . .	1,054,022	573,296	54·4
1st January 1898 . .	1,110,045	674,675	60·8
1st July 1898 . . .	1,113,745	784,596	70·4

Description of Couplers in use.—At present there are about eighty different variations of the M.C.B.* coupler in use in the United States; but owing to the fact that they are all on the lines of the Master Car-Builders' Standard, conforming with the leading dimensions shown in Fig. 2, and having the contour line shown in Fig. 1, any one coupler will engage with any other, although the locking mechanism may vary; moreover, of the total number of couplers in use in the States about 70 per cent. are of the Janney type.

It may be asked how it is that the rolling stock of the United States is almost exclusively fitted with automatic couplers, whilst in this country they are comparatively rare. To understand this fully, it must be remembered that the old form of American coupler was the "link-and-pin" coupler, Fig. 3, which did not require side buffers. When the Master Car-Builders' coupler was introduced, it had the merit of being readily made to couple with the old attachment. This link-and-pin arrangement, moreover, was the cause of such an enormous number of accidents that the railway companies in America decided to look out for an improved coupler. The number of accidents in this country never reached that in the United States of America; in fact, in 1898, when the majority of vehicles in the States were fitted with automatic couplers, 1 in 486 servants employed on the railways was killed, whilst in this country

* The Master Car-Builders' Coupler is generally known as the "M.C.B." coupler.

the proportion was only 1 in 1060, and in the United States 1 in 30 was injured as against 1 in 128 in this country. It is partly due to these facts that railway experts in this country have not given so much consideration to the question of automatic couplers as the American engineers.

In 1882, however, an automatic coupling was exhibited at Darlington, and in 1886 some trials took place at Nine Elms and Derby. At the former place the "Brockelbank" coupler was exhibited, Figs. 4 and 5, Plate 41, which made a favourable impression on the minds of some of those present. A full account of the performances of this coupler up to this time may be seen in the Journal of the Society of Arts, in a lecture* delivered by Mr. Brockelbank in 1876.

Since then some of the railway companies have expressed themselves as being on the look-out for a suitable coupler. On some of the principal railways automatic couplers have been and are now employed on vehicles used in passenger trains. One of these is the Gould coupler, which is of the M.C.B. type, somewhat similar to the Janney. In 1899, legislation on the subject was attempted in this country. A Bill was introduced by Mr. Ritchie, President of the Board of Trade, giving this body power, after five years had expired, to make an order upon the railway companies to apply a suitable form of automatic coupler after another term of years—provided such suitable coupler could be found during the first five years. This Bill was subsequently rejected.

In Australia, France, and other countries, experiments have been and are being made with automatic couplers; the question may be said to be in an experimental stage on the Continent. In India automatic couplers are used to a considerable extent, the form adopted being the "Jones" type; this coupler is of an entirely different form from that adopted by the Master Car-Builders' Association, being of the "Norwegian hook" type, and a description is given on the next page. It was first introduced on the Indian State Railways in 1883. The couplers used on many of the

* Journal, Society of Arts, 1876, vol. 24, page 415.

Government Railways in Australia, South Africa, and Natal, are semi-automatic, and are known as the "Johnston" couplers; they are of the "link-and-pin" type.

Description of various types of Couplers.—An automatic coupler is one which is capable of self-coupling by impact. It is usually connected to a central buffing and draw gear, although coupling devices have been applied to side buffers. Cheesewright's coupler is an example of this, consisting of the Norwegian hook adapted to side buffers. There is also a later design, which consists of two Master Car-Builders' couplers in the position of side buffers—each acting as a buffing and draw gear. The automatic couplers in general use are of the following kinds:—

(1) Norwegian Hook — the Standard of the Indian States Railways, also used in Australia.

(2) The Master Car-Builders' or American type.

The best example of the Norwegian hook type of automatic coupler is the "Jones" arrangement Fig. 9, Plate 42, which was selected out of many, and adopted by the Indian Government for application to the States Railways. In this arrangement, when the vehicles are buffed together, the hook A, which is pivoted at B on one head C, strikes against a bar D on the other head E, and, due to the angle of inclination of the face F of the hook A, it rises, and passing forwards it engages with the bar D. In order to effect tight coupling, the bar D is drawn backwards towards the headstock H by means of the right- and left-handed screw K and the link-work L L_1 L_2. In this manner the two buffer faces, M and N, are fixed so tightly together that the two draw-bars become practically one solid rod. Referring to Fig. 6, Plate 41, it will be seen that when the vehicles are on a curve, the centre line of the coupling *a–b* will stand at an angle with the centre lines of the vehicles *c–d*, *e–f*; consequently allowance must be made for the necessary radial motion of the draw-bar. It was found that, when the vehicles stood on a curve, the friction against the knee P, Fig. 9, due to the draw-bar being at an inclination to the axis of the vehicle, was sufficient to wear the bar down, so that its strength was materially reduced. To

obviate this the rod R was made perfectly free of the knee P as shown.

When the vehicles are of different length, and are put on a sharp curve, the coupler of the longer vehicle will stand farther out from the rail centre than that of the shorter, so much so that it was found impossible to couple on sharp curves. To overcome this difficulty the guide vanes V_1 V_2 V_3 V_4 were introduced. They are really extensions of the buffer faces in an outward direction, the top half to the right and the lower to the left (looking from the vehicle), and are inclined forward at an angle of 45°. The result is that when the couplers meet on a curve at different inclinations to and different distances from the rail centre, they mutually engage and guide each other into the central position as shown on Fig. 9. But in order to effect this desired result, it is necessary to give the couplers a greater degree of flexibility than before; for this purpose the india-rubber pads, X and Y, are introduced, securely bolted to the knee P, the casing Z, and the guide casting S. The buffing and draw springs are the india-rubber springs G, which fit fairly tightly in the casing Z, and are clear of the draw-bar. In this manner the whole arrangement is flexible, and is capable of being turned through a considerable angle relatively to the headstock. The original "Jones" flexible buffer and coupling was designed—(a) to remove all wear by abrasion—abrasion being removed by tight coupling which necessitates flexibility; (b) to enable the Indian State Railway to run double trains. When loose coupled it was found that the snatch at the rear end of the train broke the couplings. Hence tight coupling was necessary, and tight coupling is not possible in a centre buffer which is not flexible, owing to the curves upon which the vehicles have to run.

The great advantage this coupler possesses over others is that it will couple automatically under almost any circumstances, a 43-foot vehicle with 25-foot wheel-base coupling easily with a 12-foot wagon, 5-foot wheel-base on a 5-chain curve.

The "Janney" coupler may be taken as the representative of the Master Car-Builders' type, for, as previously mentioned, it is that found upon the majority of railways in the States. Fig. 7, Plate 41,

shows a sectional elevation and inverted plan of this coupler. A is the main casting of the coupler, having a "guard arm" B, C is the knuckle pivoted by means of the pin D, and capable of turning through an angle of 90°. When uncoupled, the knuckle is in the position indicated by the chain lines, and upon two of the couplers coming together the tail of the knuckle is turned through an angle of 90° and locked in position, in the case of the Passenger Car coupler by the "catch lever" H, which in the later forms is operated from the end of the coach by means of a connecting lever. In the case of the freight-car coupler, this catch lever is replaced by a "locking spring," which is also operated from the end of the vehicle. The buffing and draw spring is shown at E. It should be noticed that the buffers F 1 and F 2 do not touch when the cars are coupled, but only come into play after the main buffing spring E is partly compressed. One great difficulty met with in the early days of these couplers in the United States of America was that wagons were sometimes buffed together when the knuckles were in the "coupled" position. This of course necessitated men going between the wagons to open the knuckles, and consequently improved forms were devised in which the knuckle could be opened from the side of the vehicle by means of a lever. The "Gould" coupler has this attachment.

The "Perry-Brown" Tandem Spring Coupler is another example of the M.C.B. type. In this case, the lever on being pulled over raises the locking bolt and the knuckle flies open. This coupler is composed of three main parts:—(1) The head and shank; (2) Knuckle or Jaw; (3) Locking bolt. The shank is of cast steel, cast either in two halves or one piece, and is fitted with two springs in the inside to take up the thrust and pull motion. These springs fit between three plates fitted in the shank through slots, and the plates are removable, allowing the springs to be taken out to be replaced. The knuckle is of cast steel, fitted to the shank-head with a steel pin. The nose of the knuckle is fitted with a hardened steel wearing plate which can be replaced when the old one is worn. The knuckle is so formed that when the coupler is closed the strain is not on the pin, and in the chance of the knuckle pin breaking or falling out the knuckle is still held fast by a "locking bolt." The

latter is an arrangement for locking and unlocking the coupler, and is worked from the side of the vehicle by means of a lever. The locking bolt is provided with a small trigger which, when the bolt falls, locks the mechanism so that the bolt cannot jump out. To uncouple the vehicle the shunter pulls over the lever, thus lifting the locking bolt and causing the knuckle to fly open.

Another difficulty that has been experienced with couplers of the M.C.B. type was that it was not easy to uncouple vehicles standing on a curve. During the last visit of Messrs. Barnum and Bailey to this country, they brought special trains over with them, which were, in accordance with American practice, fitted with Master Car Builders' couplers. It was found impossible to uncouple these trains whilst standing at Willesden Junction Station without putting an engine on to the end of the train and backing slightly to relieve the tension on the draw springs. In the early days of these couplers it was found that trains parted, due to the couplers becoming disengaged in a mysterious manner without opening the knuckles. After considerable investigation it was found that the pin was disposed to creep up, owing to the friction of one knuckle upon the other; this was remedied by putting a little tooth into the locking spring.

In a report of the Master Car-Builders' Association dated June 1897, it is shown that of 5,755 cases of trains parting, 2,155 were due to failures in the automatic coupler. Many of these were due to defective material, some to the creeping of the locks, and some to other points of weakness. The chief points of wear on these couplers are the heel of the knuckle which comes in contact with the guard arm of the opposing coupler, the inside of the guard arm, the inside face of the knuckle where the pull is most severe, the pivot pin-hole in the knuckle and the lug of draw-bar, the pivot pin, and the locking surface of the tail of the knuckle, any of which might cause a break away.

Another coupler, used to some extent in the United States of America, is the "Miller" coupler, Fig. 8, Plate 41. In this case the buffer B and draw-hook A are entirely separate, and are controlled by separate springs. The great objection to the "Miller" form is the trouble experienced in uncoupling, which is difficult

at all times and may become impossible on curves. This coupler dates from before the time of the "Janney" coupler, and is generally acknowledged to be inferior to it. The "Miller" arrangement is really the origin of the American automatic coupler, a development of it having a knuckle release, which was further developed by the "Janney" coupler.

Ideal Automatic Coupler.—Some of the requirements of an ideal automatic coupler are:—

1. It must be capable of coupling automatically by impact, and should uncouple without the necessity of men going between the vehicles. This, as already pointed out, has been accomplished by many couplers.

2. It should be reliable and inexpensive. In the early days of the "Janney" coupler, cases of trains parting, due to failure of the couplers, were very frequent. The question of cost is of course very important. It is difficult to conceive a form of coupling which would be less expensive than our three-link coupling. The introduction of the Master Car-Builders' coupler in the United States of America has caused a considerable increase in expenditure.

3. It should be capable of coupling not only the draw-bars of the vehicles, but also where necessary the brake-pipes, and in some cases the heating pipes, and passenger communication. Experiments have been made in this direction, but, so far as the author is aware, without any satisfactory result. A coupling recently invented by Mr. George Westinghouse for use on electrical coaches is said to couple not only the draw-bars but also the air-brake pipes and electrical connections.

4. It should be capable of coupling the longest vehicle with the shortest whilst standing on the sharpest curve, and of uncoupling easily under the same conditions.

5. A coupler which is to be adopted in Great Britain must be capable of coupling during the transition stage with all the forms of couplings now in use in this country. Figs. 10 and 11, Plate 42, are photographs of an arrangement of the "Buckeye" coupler, which can be used as a Master Car-Builders' coupler, Fig. 11, or as an ordinary

draw-hook, Fig. 10. It is worked in conjunction with side buffers, which are of the "Spencer" form, Fig. 12, being so arranged that the distance between the face of the buffer A and the headstock H can be varied, by means of the insertion or omission of a "slipper" S. When the automatic coupler is in use, the slipper S is removed, and the length between the buffer face A and headstock H in each vehicle is reduced by sliding the buffer rod C back and fixing it in this position by the set screw B, so that the buffer faces of the opposing vehicles do not touch. When the draw-hook is used, the slippers S are inserted, and the buffers thus packed out so that they act as side buffers in the ordinary way.

Adoption of the Automatic Coupler in Great Britain.—It is by no means easy to predict the future of the automatic coupler in this country. Although the railway companies have been trying to discover an automatic coupler suitable for use on the railways of this country, there appears to be in the minds of some of the leading mechanical engineers in the railway world considerable doubt as to the advantages to be obtained from its use. Mr. S. W. Johnson, of the Midland Railway, in stating his opinion "as an engineer" before the Royal Commission of Accidents to Railway Servants in 1899, said that he did not approve of the automatic coupler, nor did he see what advantage there was to be derived from it. He thought that the "Gedge" coupling and the buffers were the best, and would prefer to keep to them. He also remarked it was possible that some arrangement would be made whereby the "Gedge" coupling could be worked by a lever at the side, and that there was not sufficient warranty for the adoption of the automatic coupler when they had a coupling like that particular one.

The railways of the United States can scarcely be said to have made a mistake in introducing their automatic coupler, as their previous system—the "link-and-pin" coupling, Fig. 3, Plate 41—was so bad. They could not adopt the British system as they had no side buffers, but the opinion of many American railway officials agrees with that of Mr. Johnson in asserting that in this country there is no case for an automatic coupling. On the other hand, the Hon. E. A. Moseley,

Secretary to the Inter-State Commission at Washington, says:—"There can be no objection to the adoption of the coupler now in use here (United States, America), namely, the Master Car-Builders' type, by reason of the difference either in length or weight of the freight-cars now used in Great Britain and those in the United States." But Sir Francis Hopwood, in his report to the Board of Trade on Automatic Couplers, says:—"Mr. Moseley . . . naturally takes a hopeful view of the American coupling." At any rate, there can be no doubt that the ordinary Master Car-Builders' coupler is not suitable for application to the existing British stock, of which vehicles other than bogie stock form a large proportion. There is not sufficient play in the ordinary Master Car-Builders' coupler to enable such vehicles to go round curves, although in some forms the coupler may be made flexible. It is a fact worthy of notice that the Act of Congress, which in 1893 made the adoption of the automatic coupler in the United States of America compulsory, made an exception in the case of four-wheel vehicles. It should be remembered that the successful employment of automatic couplers in the United States does not necessarily establish that they can be advantageously adapted to wagons in use in this country. The curves, in the United States, are neither so numerous nor so sharp as those in the shunting yards of the United Kingdom. The wagons of the United States vary in capacity from 30 to 50 tons and are bogie vehicles, whilst our wagons have until recently rarely exceeded 10 tons, having four wheels. This being so, an entirely flexible coupler, such as the "Jones," Fig. 9, Plate 42, is far more suitable than the Master Car-Builders' coupler. But the great objection to the adoption of automatic couplers in this country is that, although they can be worked in conjunction with the side buffers now in use, they are in themselves centre buffers; and it is only necessary to compare the cost of an automatic coupler (of either the Norwegian Hook or Master Car-Builders' type) with that of the ordinary Gedge hook and three-link coupling, to see that until the railway men in this country become firmly convinced that an automatic coupler is a necessity, the progress of these couplers will not be rapid.

The question of expense is not the only consideration which hinders the adoption of the automatic coupler in this country, although the cost of such would in many cases be a large percentage of the cost of the vehicle. But there are also the apparently insurmountable difficulties of the transition period to be overcome. Many devices have been tried, but all have their faults. Amongst these are the arrangement of the "Buckeye" coupler as illustrated in Fig. 10 and 11, Plate 42, and the Westinghouse couplers. In the case of the latter the link on the coupler, which engages with the ordinary draw-hook which opposes it, is so placed that the pull is not directly through the draw-bar, but in an upwardly oblique direction. The conditions which an automatic coupler in this country should fulfil are:—

1. It should be applicable to spring buffer wagons.
2. It should be applicable to wagons on a curve.
3. It should be capable of coupling when one wagon is light and the other loaded.
4. There should be no tendency on the part of the combination to jump off the drawbar-hook if the vehicles are shunted together.
5. There should be no chance of the combination becoming jammed, if the vehicles are buffed sharply.
6. There should be no chance of the uncoupling gear of one wagon becoming entangled with the other.
7. The apparatus should be out of the way of any capstan ropes and brake gear.
8. The apparatus should have as few joints as possible.
9. The apparatus should provide means of coupling with the Gedge-hook.
10. It should not be necessary for a man to go between the vehicles to couple or uncouple.
11. It should be easy of access and renewal at any part of the line.

It is undoubtedly a fact that the leading men of the railway world of Great Britain are very anxious to do all they can to protect their servants from injury, and if it were an individual matter they would spare no effort in finding a coupler suitable to their

requirements. Having done so, the automatic couplers would be given a fair trial, with a view to finding out whether the number of accidents was reduced. It must be remembered however that the coupler must be suitable to universal application, and consequently the matter does not rest with individual effort.

It may be mentioned that, since the adoption of the automatic coupler in the United States, another source of danger has arisen. Knowing that there will not be a man between the cars, the shunters "bash" the cars together to ensure their coupling, and sometimes the end timbers are thus started; the fault is not discovered until an accident occurs. Then again there is also a tendency in uncoupling to throw over the levers at the end of the cars and pull, without first uncoupling the train-pipe connection. The result is that the latter are uncoupled forcibly and strained, causing leaking train-pipes and insufficient brake pressure.

The author wishes it to be distinctly understood that he does not profess to have treated this subject in any other than a most superficial manner, for the obvious reason that in 1900 about 550 patents had been filed at the British Patent Office for automatic couplers. By this time the number has probably reached 800, whilst there are several thousands in the United States; consequently a full treatment of the subject would fill several volumes.

The author wishes to express his best thanks to Messrs. George Spencer, Moulton and Co., Mr. O. Winder, Assistant Carriage and Wagon Superintendent, Lancashire and Yorkshire Railway, Mr. W. R. S. Jones, formerly Carriage and Wagon Superintendent, Rajputana Malwa Railway, and other gentlemen who have favoured him with information and advice.

The Paper is illustrated by Plates 41 and 42.

Fig. 1. Form of "Contour Lines" for M.C.B. Standard Coupler.

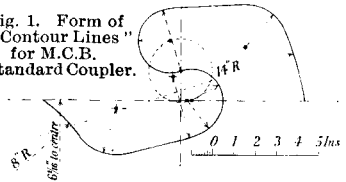


Fig. 2. General View of the M.C.B. Standard Coupler.

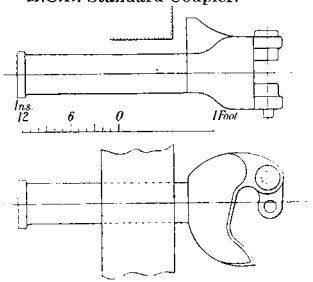
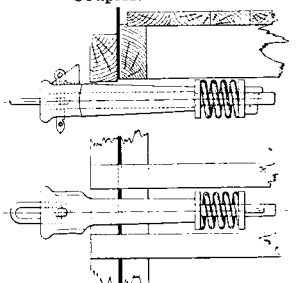


Fig. 3. "Link and Pin" Coupler.



Coupler (Brockelbank).

Fig. 4. Applied to 8 and 10-ton Wagons.

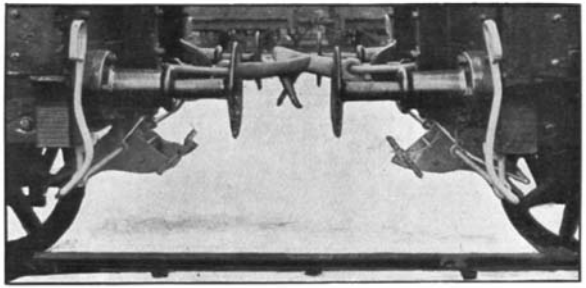


Fig. 5. The same, viewed from above.

Fig. 6 Diagram showing the Inclination of the centre line of the Coupler to the centre lines of two 50-feet Coaches on a 5-chain Curve.

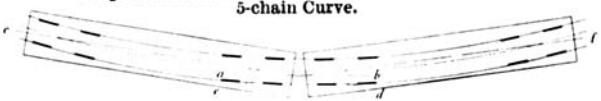


Fig. 7. Coupler (Janney).

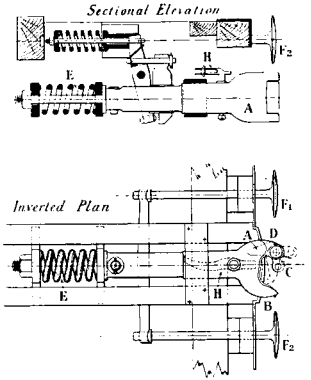


Fig. 8. Coupler (Miller).

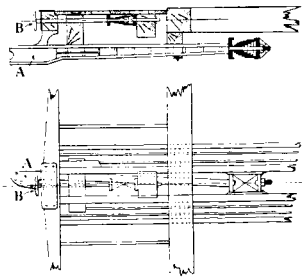
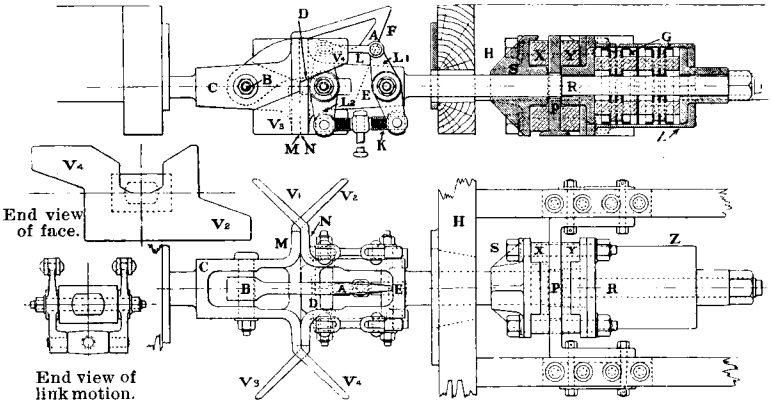


Fig. 9. Flexible Centre Buffing and Draw Gear and Self-centreing Coupler (Jones').



Coupler (Buckeye).

Fig.10. Used with a 3-link or screw coupling.

Fig. 11. Used as a M. C. B. Coupler.

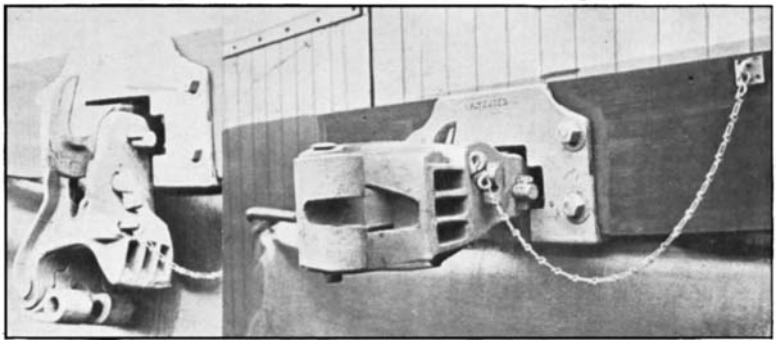


Fig. 12. Slipper Buffer (Spencer).