



MINISTRY OF LABOUR AND NATIONAL SERVICE

Report of the Joint Standing Committee

- on the

Safety of Heavy Power Presses

BENDING BRAKES

LONDON

HIS MAJESTY'S STATIONERY OFFICE

1945

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INTRODUCTION

In paragraph 10 of the Report, published in 1939, of a Committee on the Fencing of Heavy Power Presses, it was recommended that a Standing Joint Committee should be appointed to consider developments which might render the recommendations in that Report out-of-date, and in paragraph 7 of the same Report it was recommended that the fencing of bending brakes should be referred to that Committee.

Such a Committee was appointed and their Report on the Fencing of Bending Brakes is now published for the consideration of all industries interested in this machine.

The specification appended to the Report sets out the performance required of a guard that will, in the opinion of the Committee, afford the necessary protection as regards the trapping area when used in conjunction with another or a similar guard to prevent access to that area from the back of the machine ; and the Report describes in detail the only guard yet on the market that meets this specification.

This particular guard was largely the work of a foreman millwright, Mr. William C. C. Short, of the firm of Messrs. Rubery, Owen & Co. Ltd. It is understood that the firm have certain Patent Rights covering the particular methods adopted in this case to obtain the result desired, but they have informed the Department that, in the cause of safety, they would ask for no royalty for the use of the patent if the guard is described and labelled as a "Rubery Owen Guard for Press Brakes" and made in accordance with drawings and specifications approved by the firm, though they would expect in the ordinary course to be remunerated on a reasonable commercial basis for services to a manufacturer or user of the guard, giving advice, providing or approving drawings or specifications, or supplying guards.

The Report is now published for the consideration of the industries concerned.

To H.M. CHIEF INSPECTOR OF FACTORIES.

SIR,

In the Report of the Committee appointed to consider the Fencing of Heavy Power Presses it was recommended that you should consider the appointment of a Joint Standing Committee to which you could refer developments in the fencing and other safety matters connected with Heavy Power Presses and in particular the Safety of Bending Brakes or Presses and Guttering Presses. The Committee considered this matter but in order not to delay the presentation of their Report, they did not deal fully with the problem. The incidence of accidents on these machines and the great increase in the use of them led in March, 1940, to you appointing a Joint Standing Committee and referring to them this problem.

2. The Standing Committee appointed consisted of the following Members.
 Mr. H. R. Rogers (H.M. Deputy Chief Inspector of Factories), *Chairman*.
 Brigadier-General A. C. Baylay, C.B.E., D.S.O., (Engineering and Allied Employers' Federation).
 Mr. L. A. L. Brown (Rubery, Owen & Co. Ltd., Darlaston, South Staffs).
 Mr. L. P. Coombes (Morris Motors Ltd., Cars Branch, Cowley, Oxford).
 Mr. F. Southwell (Vauxhall Motors Ltd., Luton).
 Mr. R. Bramley-Harker (H.M. Engineering Inspector of Factories), *Secretary*.

3. The Committee commenced its work immediately after appointment but owing to matters connected with the war, no meeting took place after 17th April, 1940, until 29th March, 1944. Since that time there have been five meetings of the Committee. During the war period there has been considerable development in the use of bending brakes and particularly in the type of work which has been done upon these machines. It became evident when the work of the Committee was resumed in March, 1944, that it would be an advantage if the help of certain large users of this type of press could be obtained. Accordingly you invited the following gentlemen to attend the meetings of the Committee :

- Mr. A. L. Busschaert (Art Metal Construction Co. Ltd., London).
 Mr. G. W. Clarke (Standard Telephones and Cables Ltd., London); and
 Mr. J. L. Munn (Austin Motor Co. Ltd., Birmingham), together with
 Mr. R. K. Mawson (H.M. Engineering Inspector of Factories).

4. A census of the numbers and types of Bending Brakes in use has been made. There are about 600 presses of this type in the country, of which about one-sixth are driven by means of positive clutches, the remainder being generally driven by friction clutches. The widths of the working beams of the presses vary from 3 feet to 15 feet and there is a further variation in the design of the machines in so far as whether the main driving shaft of the machine is beneath the working bed of the machine or above it. When there is added to these variations the almost infinite variations in the type of work being performed, for example, from simple punching of holes to the bending of trays, of tubes and rectangular shaped enclosures such as in furniture manufacture, it will be appreciated that to find a satisfactory safety device which is universally appropriate for all operations is difficult.

5. The law relating to the fencing of the trapping area of the tools on bending brakes is set out in Section 14, Factories Act, 1937, and by its implications and interpretations, there is no doubt that this section requires the use of a fixed guard in every case where the nature of the operation permits of it. The type of guard usually connoted by the term 'fixed guard' is a static fixed enclosure secured to the press so that there can be no access of the person to the danger area.

Subsequently in this Report we refer to such a guard as a *static fixed guard*. There is, however, another type of fixed guard which we term *the interlocked fixed guard*. It is based on two principles :—

(i) When the guard is open and access is allowed to those parts dangerous when in motion, the driving mechanism of the press is so controlled that a stroke cannot be made.

(ii) When there is danger from the parts in motion, the guard is fixed in a closed position so that access to these parts is not possible.

6. There are two particular features to be noted in the construction of the modern bending brake, which have to be considered in relation to any safety device, other than a static fixed guard, which may be fitted. As noted in paragraph 4 of the Report, more than 80 per cent. of the presses in use incorporate friction clutches, and in the case of these machines there is no positive clutch withdrawal mechanism to ensure that a second or repeat stroke will not take place. Indeed if the operative retains the pedal or other clutch operating device in the operating position, a second stroke will take place. On the other hand, if the operative releases the clutch control, then the clutch will be withdrawn at once. This latter feature is of value in the actual use of bending brakes for because of it, it is practicable to "inch" the beam or top tool on to the work or component when it is in its position on the die and so ensure accurate working and moreover to avoid "bruising" of the metal by an impact ; this is important in high class metal working.

7. We see no practical reason, however, why every clutch driven machine should not be fitted with a positive clutch withdrawal device. We recommend therefore that every machine should have fitted to the clutch whether the clutch be of a positive or friction type, a withdrawal mechanism which will effectively render the press single stroking and prevent any second or repeat strokes except those due to mechanical defects in the clutch. Arrangements may be provided to enable continuous stroking when static fixed guards are used. The fitting of such a device should not interfere with the quality of the clutch to permit "inching." It is desirable that the single stroking device should be mechanically operated and positive in relation to the crankshaft rotation ; for this reason the use of electrical solenoids and thrusters or of compressed air as a means of clutch withdrawal is not recommended. We have seen such devices fitted and at least one large maker of the machines has told us there is no practical difficulty in the provision of a positive clutch withdrawal device on all presses.

8. We have stated that the universal use of a static fixed guard is not practicable, and we have considered three further methods of guarding which have been the subject of considerable experiment.

(1) The use of the interlocked distance bar which should be in a position of effective safety before the ram can descend.

(2) The use of an interlocked rise and fall screen (interlocked fixed guard) which should be in such a position as effectively to prevent the fingers from reaching into any part of the trapping area before the clutch can be operated to permit of the descent of the beam, and consequently be fixed in such safe position before the tools can be in dangerous proximity.

(3) The use of the automatic guard which embodies the principle of the mechanical removal of the operative to a safe distance from the danger area before trapping can occur.

9. The type of automatic guard which has been used on bending brakes consists of a horizontal bar immediately in front of the press anvil and extending the full width of the machine, which, when the beam descends, is driven forward so as to remove any person standing within reach of the trapping area. A variation of this principle is where the device is designed so that the guard bar must be pulled forward to a safe position before the clutch can be engaged but in the event of a repeat stroke the guard acts as described previously. The normal stroke of the beam of a bending press is 3 inches and the safe distance of the operative from the trapping area is not less than 36 inches. It has been found that in order to remove a person within the available time, a high rate of acceleration must be given to the guard bar and in those instances where it has been tried there have been a number of injuries to persons removed, due to this high acceleration and speed. This particular type of guard often referred to as the "body push" was considered by the Committee on Safety of Heavy Presses. One of the considerations in its use on heavy presses was the possibility of overturning operatives and this possibility is greater in the case of bending brakes for the normal height of the anvil above the floor and consequently of any guard bar is somewhat lower than in the case of the usual heavy press. Moreover, this particular type of guard would be impracticable for special work for which the machines are used and to which we refer in the following paragraphs.

10. One of the operations carried out on bending brakes is the bending of large sheets of metal which project either at the front or at both the front and the back of the beam, and it is necessary, in order that the effect of "reverse bend" may not be obtained, for the operative(s) to handle the sheet of metal so as to take the weight of it as it lifts upwards from the horizontal plane almost to the vertical plane of the beam itself. This means that during the time that the operation is being done the operative must be able to handle the component and approach near to the beam. It should be noted that once the upper tool attached to the beam is in contact with the component on the brake table or anvil, there is no longer any danger for there is no trapping space and the movement of the ram must be either downwards while in contact with the work, or upwards after completing the work. It is sufficient, therefore, assuming that there is complete control of the clutch to prevent a second or repeat stroke, for access to the danger area to be prevented only during that portion of the downstroke of the beam between top dead centre and the point where the tool comes in contact with the component.

11. There is another important factor in the use of bending brakes for operations on large sheets of metal. As previously remarked, when a bend is made the metal swings from the horizontal plane towards the vertical plane and any safety device in front of the beam at the tool level would frequently be fouled by the metal sheet. This factor is the very one which often precludes the use of the static fixed guard. If a screen is used in front of the beam at the level of trapping, arrangements must be made in its design for it to be mechanically lifted out of position before the metal swings up to foul it.

12. The use of the interlocked distance bar has been found practicable under certain circumstances but its use cannot by any means become universal and the object we have in mind is to specify a universal safety device. The interlocked fixed guard or screen is, in our opinion, such a safety device, and we recommend, therefore, that each bending brake should be fitted with such a device as will comply with the specification given in the Appendix, unless the only work required from the machine can be carried out with a static fixed guard.

We consider it of fundamental importance, therefore, that all new machines before delivery to the user, should be fitted with an interlocked fixed guard in accordance with the specification.

13. There seems to be a considerable body of work or processes carried on with the use of bending brakes which would not readily permit the general use of the static fixed guard. Much can be done by tool design to increase this field of use, but even then there can, in our view, be only a limited use. A fixed guard is the legal requirement where it can be used and the static type of this guard is one which gives the maximum degree of protection. When properly designed and maintained it prevents access to the trapping area at all times and accidents are therefore prevented. Such guards should, however, be of sufficient height to prevent injury to the hands or fingers by contact with nuts or other projections on the beam or ram. It is considered by the Committee that static fixed guards are suitable and practicable for all or any of the following operations except when these operations are carried out simultaneously on the same machine with operations other than these mentioned.

- (a) Flattening, when this operation follows over-square bending.
- (b) Embossing, ridging, grooving, joggling and off-setting where the depth of the operation does not exceed $\frac{3}{8}$ ".
- (c) Closing (as in closing to a wire bead).
- (d) Multi punching, notching, slotting and other flat sheet manipulation.

We have considered carefully all aspects of the use of the static fixed guard and the interlocked fixed guard. It is our view that the interlocked fixed guard will meet legal requirements for all operations on bending brakes, and therefore unless static fixed guards are used the interlocked fixed guard is the appropriate safeguard for these machines.

14. A most important matter in the safety of these presses is that there should be efficient inspection and upkeep. We have seen a machine on which the brake was so badly adjusted that although the clutch had been disengaged before the crankshaft reached top dead centre, nevertheless the beam descended to the half stroke position. The brake on each machine should be so efficient as to bring the ram to rest after not more than 10° revolution of the crankshaft. In connection with this aspect, when the clutch withdrawal mechanism is fitted to the machine, the clutch should be withdrawn after about 300° revolution of the crankshaft from top dead centre, and this will mean that normally the crankshaft will come to rest before top dead centre is reached. The chance of a fall-back should be dealt with by the fitting of a stop to prevent this. The stop should be positive but may be spring loaded for the purpose of placing it in position. Similarly it is considered desirable that consideration should be given to the provision of devices to prevent "overrun" in the event of brake defect.

15. The rate of manufacture and fitting of these safeguards is a material point which should be mentioned. There are 600 machines at least to be dealt with. If every machine is to be made safe within a reasonable time special consideration will have to be given to this aspect for there are at least 18 different makes of machines, many of them differing even among the machines by the same maker. We sought to induce the makers of the safety devices for power presses to pool their designing resources so as to obtain standard guards and clutch devices for bending brakes, thus cutting out duplication of design, and leaving only detailed work to be done in respect of individual machines. The guard makers were not, however, in a position to do so owing to present commitments in other directions. It should be borne in mind too that at the present the great majority of these presses are working without safety devices, this in contravention of the Factories Act, 1937. In fact, we have heard of proceedings being taken in the Courts following accidents on these machines. The need for production of guards is, therefore, a serious matter.

16. It has been commented in paragraph 15 that the great majority of these presses are at present not fitted with any sort of safety device or guard and there is no doubt that if a safety device is fitted there will be, at any rate, at the beginning, some interference with output. There may consequently be some objections to the fitting of these particular safeguards and we recommend, therefore, that the making of Regulations under Section 14(2) of the Factories Act, 1937, should be considered. We recommend further that Regulations under Section 17(3) Factories Act, 1937, should be made to implement our recommendation in paragraph 12 so far as concerns new machines.

17. SUMMARY OF RECOMMENDATIONS.

Summarising our recommendations we are of the opinion that

(a) Each machine should be fitted with :—

(i) A positive clutch withdrawal device, as recommended in paragraph 7, so as to provide for effective single stroking.

(ii) Effective devices to prevent gravity fall of the ram by fall-back due to brake defects, as recommended in paragraph 14.

(iii) The interlocked fixed guard in conjunction with the positive clutch withdrawal device, as recommended in paragraph 12.

(b) (i) A system of examination and upkeep of bending brakes should be devised in each factory.

(ii) The development of devices to prevent overrun, that is, movement of the crankshaft past top dead centre after disengagement of the clutch occasioned by brake defects, should be studied.

(c) Consideration should be given to the making of Regulations under the Factories Act, 1937, to give legal force to our Recommendations.

18. The successful development of the interlocked fixed guard which we recommend has been largely due to the work of Mr. W. C. C. Short, the Foreman Millwright in the Motor Wheel Department of Messrs. Rubery, Owen & Co. Ltd., Darlaston, South Staffs. The rights of the patent of this version of the interlocked fixed guard are vested in Messrs. Rubery, Owen & Co. Ltd. We feel that this type of guard is the ready solution of the problem before us. We wish to record our appreciation of the work of Mr. Short and Messrs. Rubery, Owen & Co. Ltd., which has made possible the development of the guard in a practical form.

19. We wish to acknowledge the courtesy accorded to us and help we have been given by the various firms whose factories we have visited; it would not have been possible to complete our work had we not been so readily helped.

H. R. ROGERS, *Chairman.*

A. C. BAYLAY.

L. A. L. BROWN.

A. L. BUSSCHAERT.

G. W. CLARKE.

L. P. COOMBES.

R. K. MAWSON.

JOHN L. MUNN.

FRANK SOUTHWELL.

R. BRAMLEY-HARKER, *Secretary.*

16th November, 1944.

APPENDIX.

SPECIFICATION FOR SAFETY DEVICE.

Interlocked Fixed Guard: A rise and fall screen extending the full width of the beam should be mechanically interlocked with the positive clutch withdrawal mechanism so that unless the screen is in a safe position preventing all access of the fingers to the trapping area, the clutch cannot be operated to permit descent of the beam. It should not be possible to move the screen from the safe position until after the tool is in contact with the component on the die. Preferably the screen should be dropped by gravity and the device should be so arranged that after the tool is in contact with the component on the die, the screen is lifted mechanically to permit of component manipulation.

In conjunction with this safety device there should be provided a static fixed guard or if necessary an interlocked fixed guard as specified above to prevent access to the trapping area from the back of the machine.

GENERAL DESCRIPTION OF GUARD.

The guard shown in the following illustrations embodies the following principles :—

When the guard is in the raised position, for placing the work on the die, the clutch operating rod is disconnected from the pedal, so that the machine cannot be operated. To operate the machine, the guard is lowered by a release mechanism to the safe position, when the machine pedal is then connected automatically to the clutch rod. The machine pedal is then depressed to engage the clutch. When the bending tool comes into contact with the component on the bed of the machine, the guard is raised ; the clutch rod is automatically disconnected from the pedal and the clutch is disengaged as the beam approaches the top of the stroke.

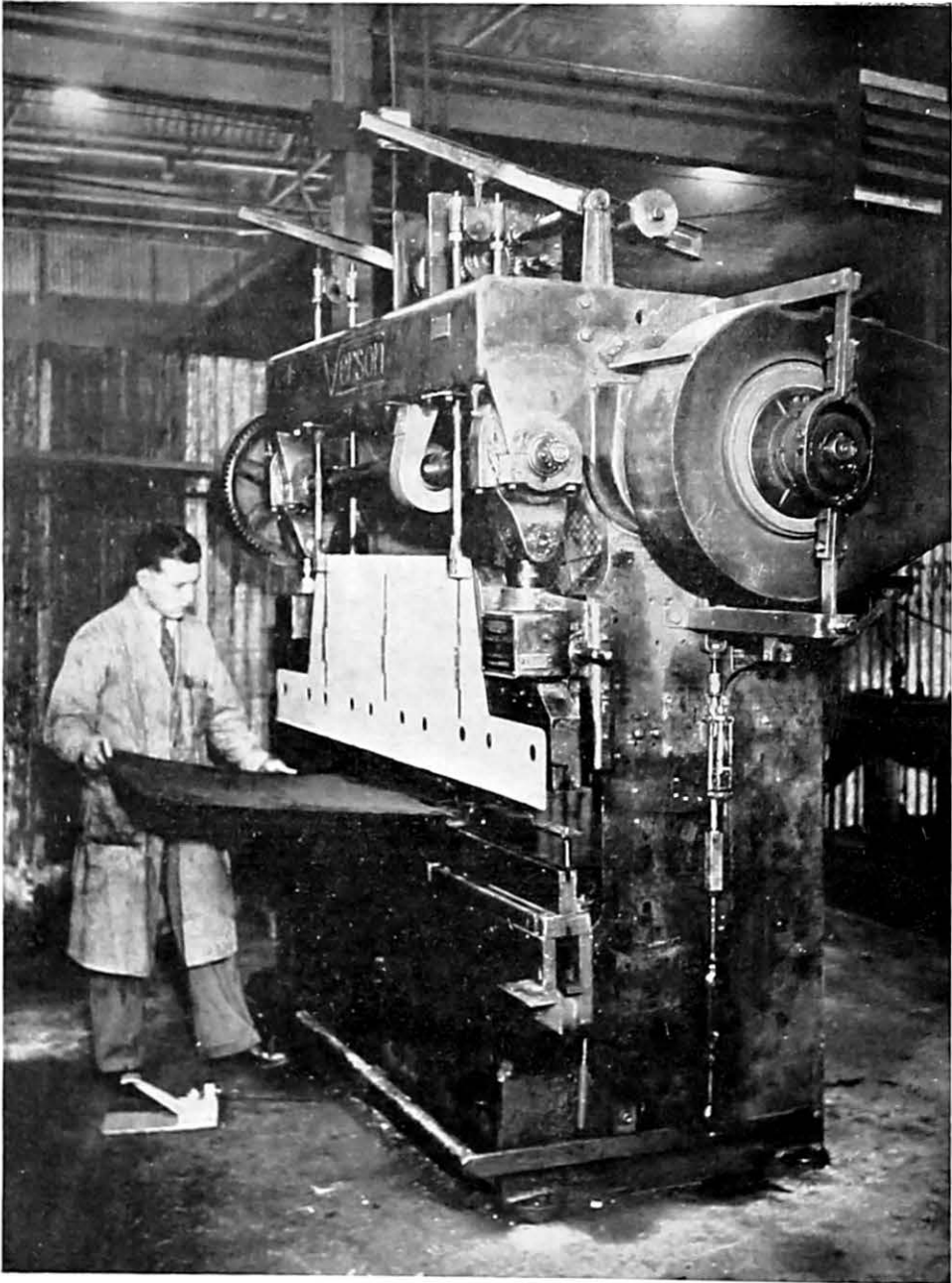


FIGURE 1.
Guard raised to feed work.

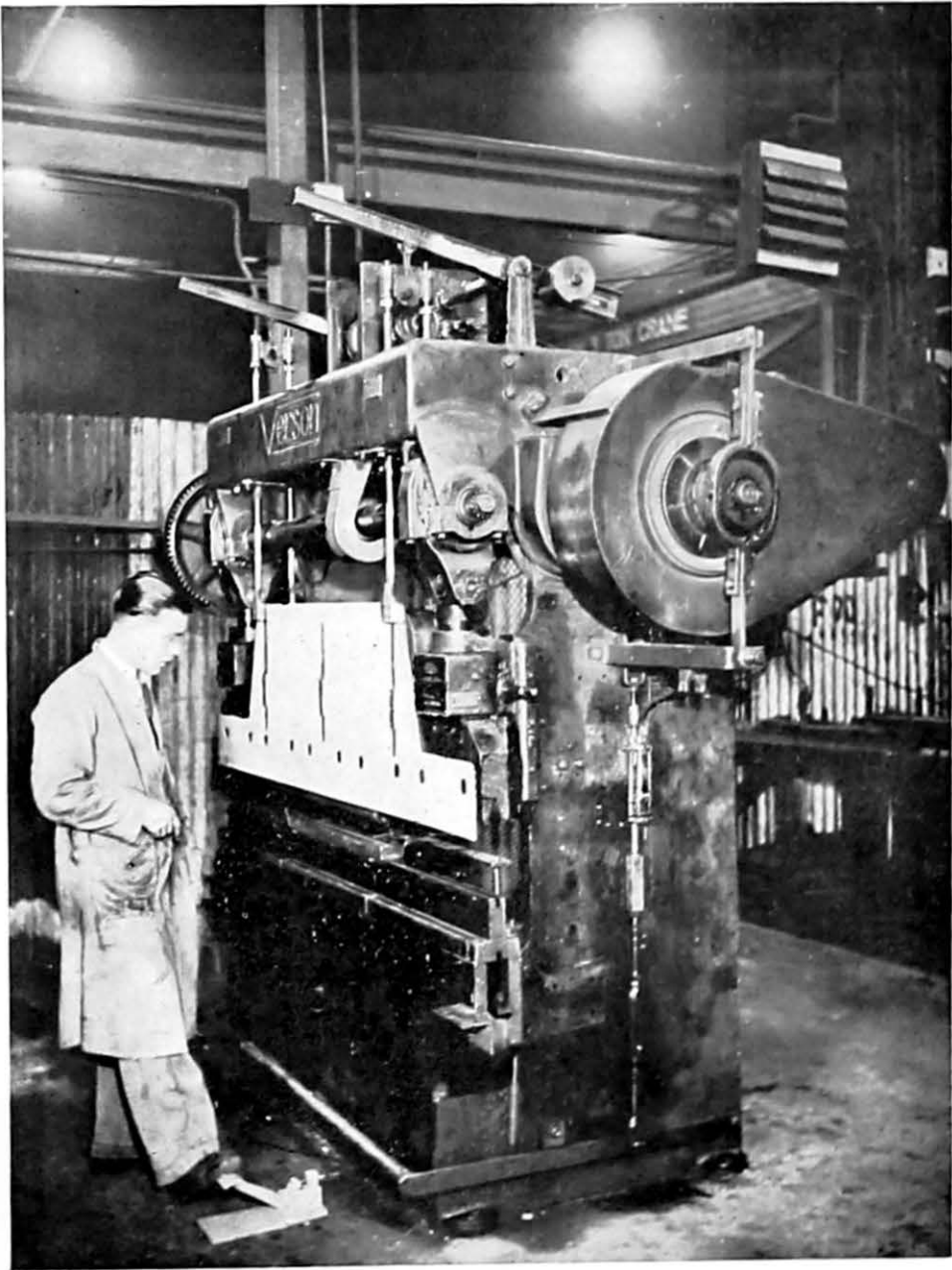


FIGURE 2.
Guard being lowered by depression of guard release pedal.

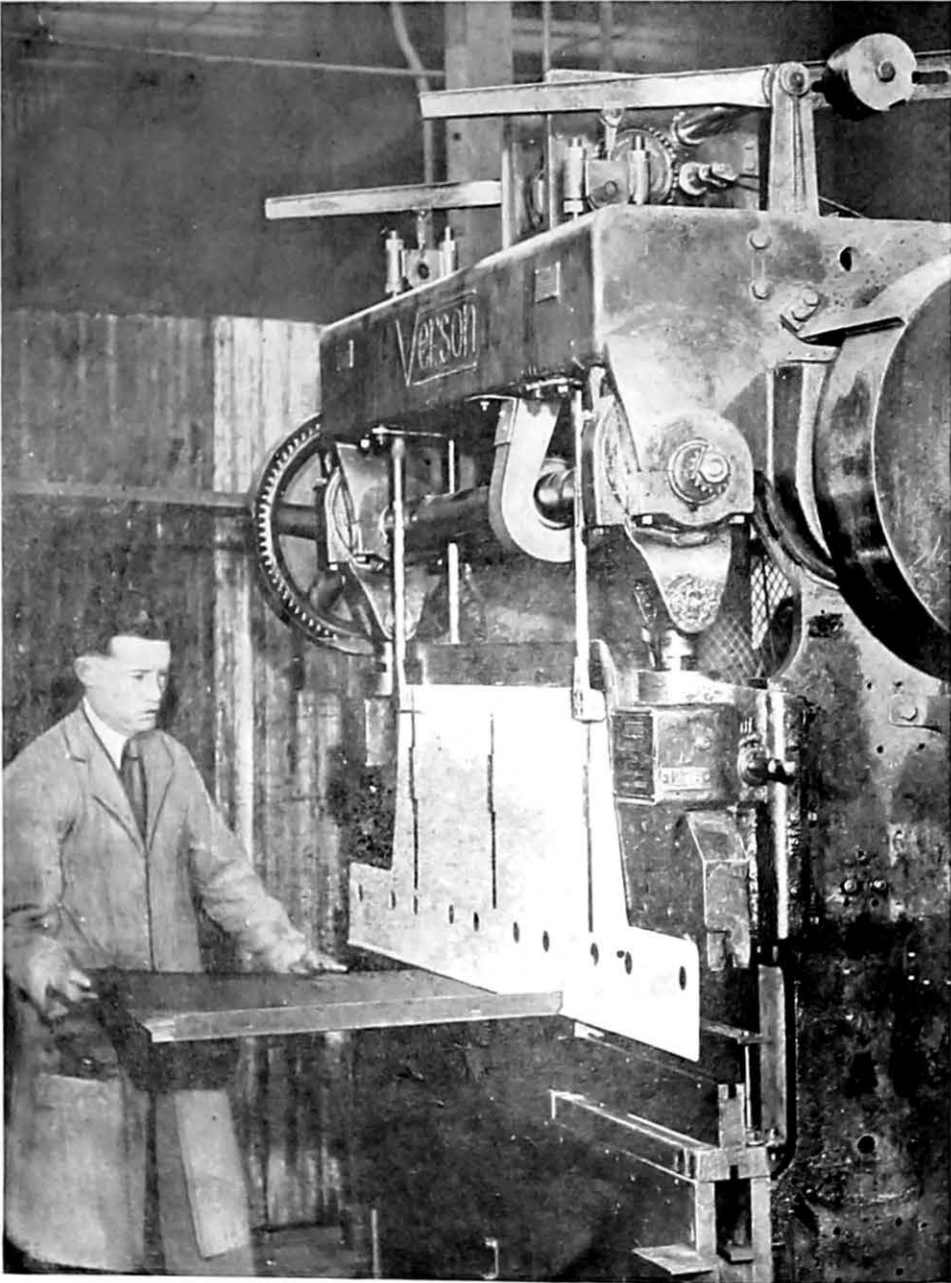


FIGURE 3.
Guard in (lower) position of secure fencing.

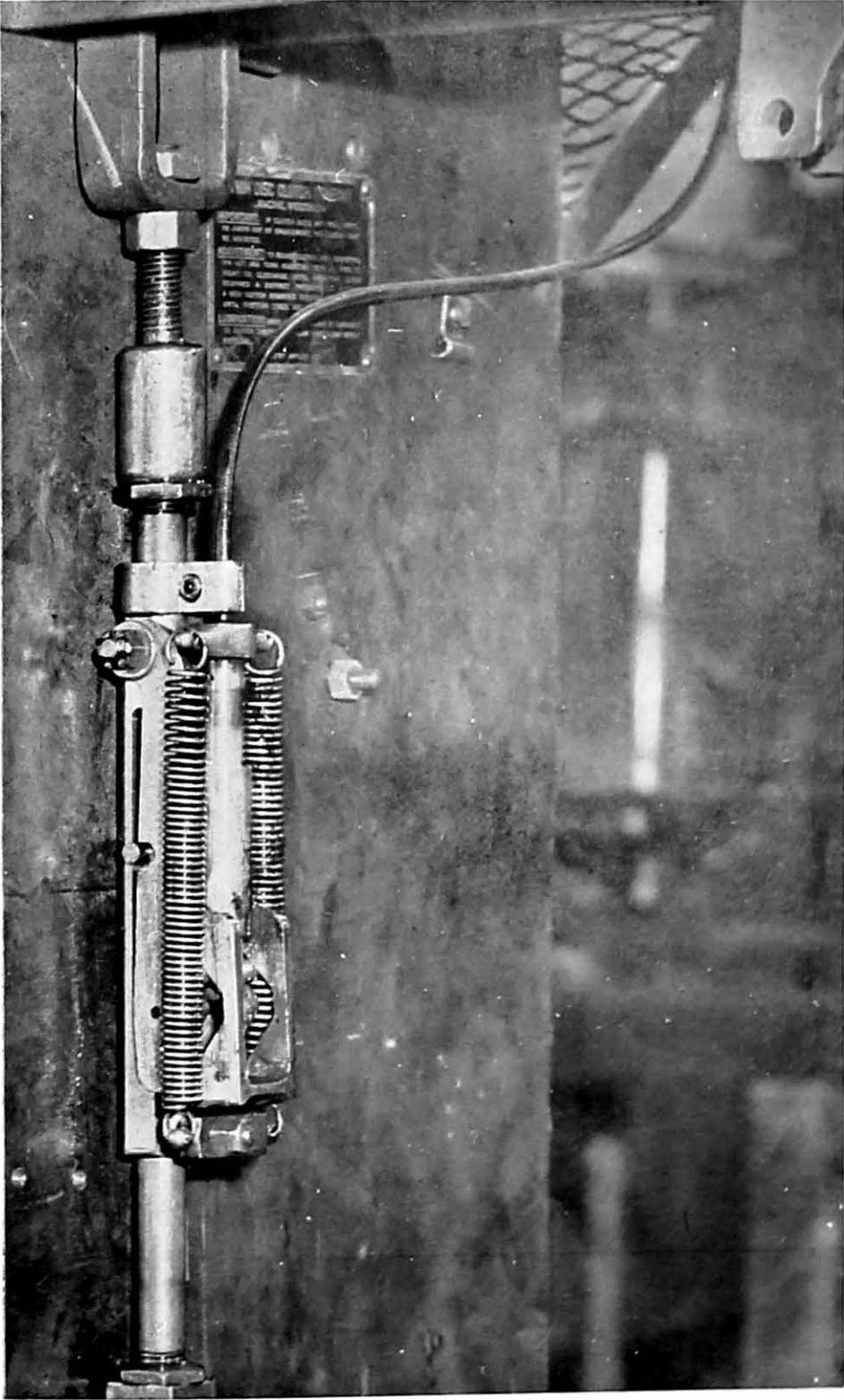


FIGURE 4.
Device for connecting and disconnecting machine pedal and clutch rod.

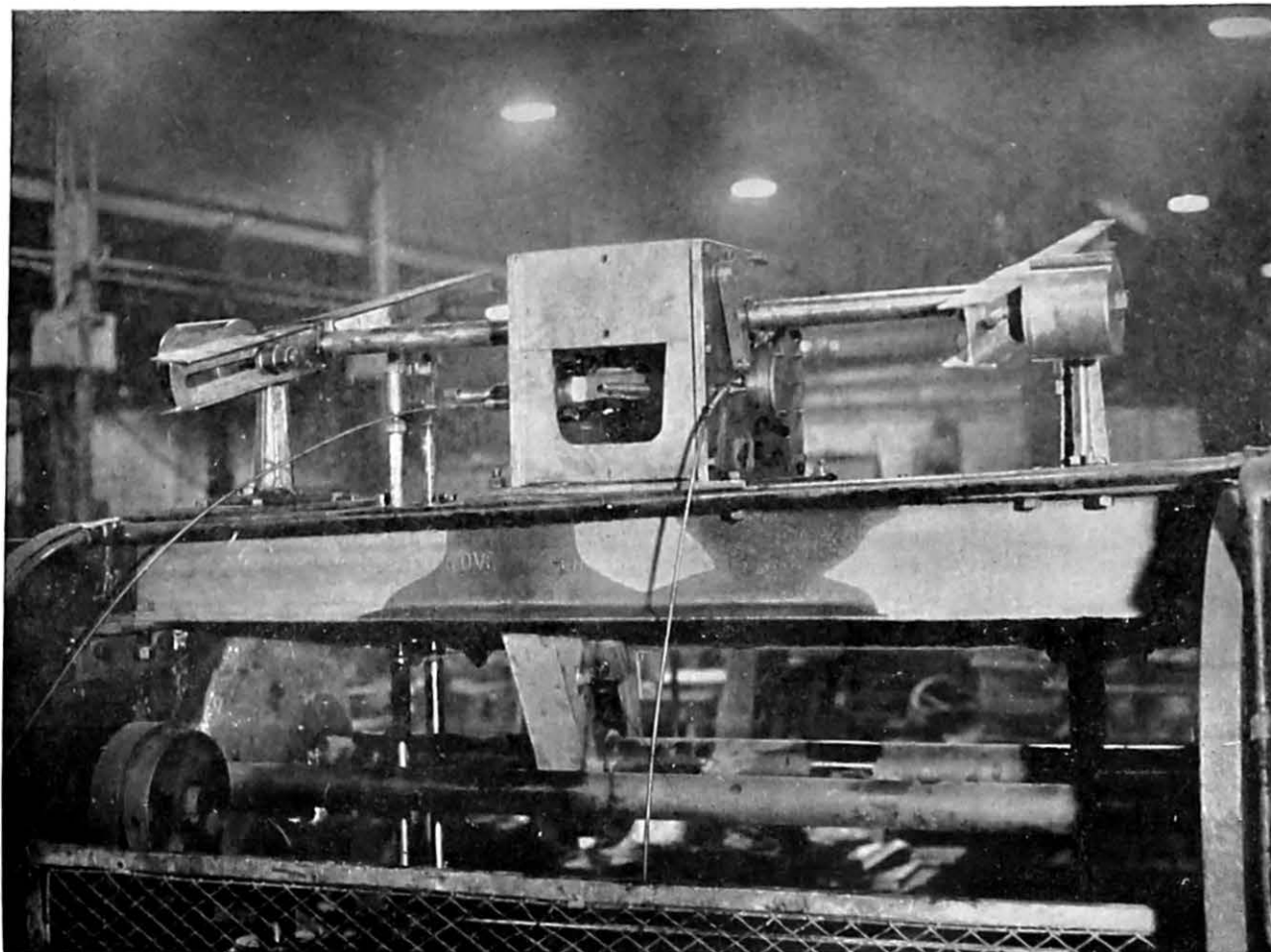
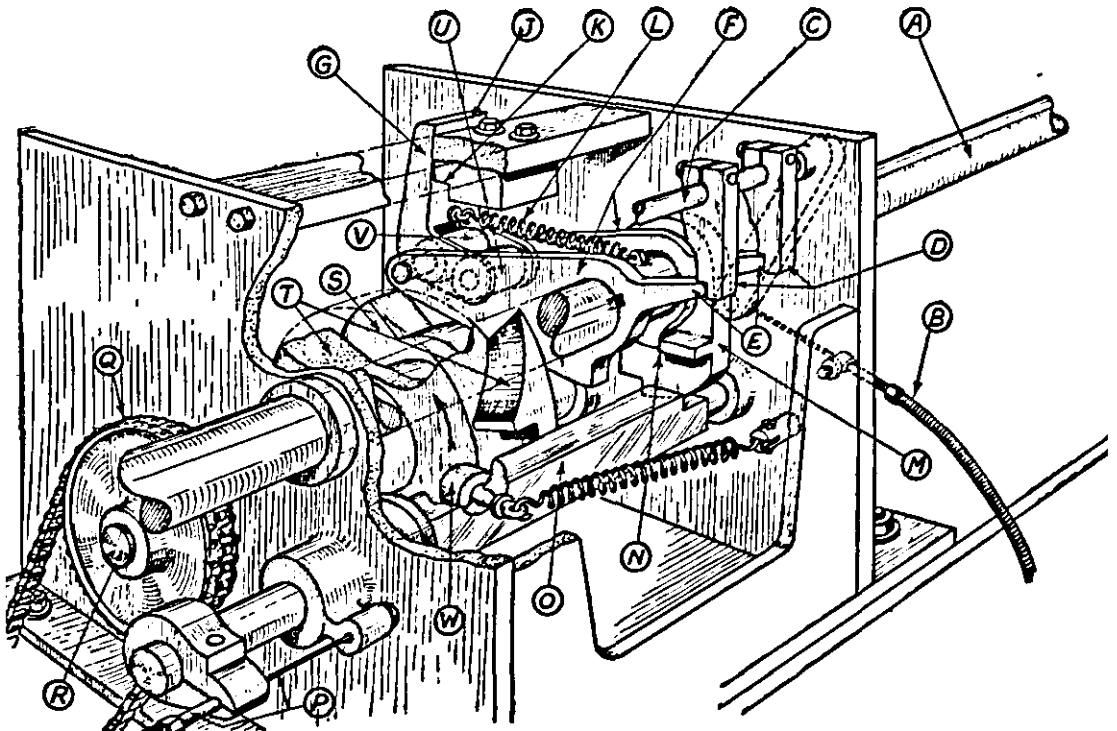


FIGURE 5
Control Box.

FIGURE 6.

Mechanism of Control Box.

The mechanism is shown in the position when the guard is raised to permit the work to be placed in position. The guard is suspended on arms secured to shaft A. When the guard release pedal is depressed, cable B turns shaft C carrying arms D, D, which move clear of lugs E, E on rocker arms F, F, keyed to shaft A. Shaft A is then free to turn and the guard falls to the lower or fencing position. As the guard falls, rocker arms F, F, rotate in an anti-clockwise direction until bell crank G is lowered sufficiently for its upper end J to pass under recess K, by the influence of spring L. The guard is then locked in the safety position. The movement of rocker arm F actuates locking plate M by contact at point N, so that when the guard is lowered M is moved clear of the notch in slide bar O. Slide bar O, under the action of the spring shown, then moves to the right actuating cable P, which operates a device to connect the machine pedal to the clutch rod. The machine can then be set in motion by depression of the treadle. Chain Q is driven by a sprocket on the machine crankshaft, and drives shaft R carrying cams S and T. The profile of cam S is so arranged, that when the beam reaches the bottom of its stroke, S contacts roller U on bell crank G and swings its upper end clear of recess K. The guard is then released. Cam S then operates on roller V lifting arms F, F and rotating shaft A, thus lifting the guard. As the beam approaches the top of its stroke, side cam T operates on roller W and draws back slide bar O to disconnect the machine pedal from the clutch rod, and the clutch is disengaged. Locking plate M which is freely mounted on shaft A, then swings back by spring action into the position shown thus locking slide bar O, the cycle then being completed.



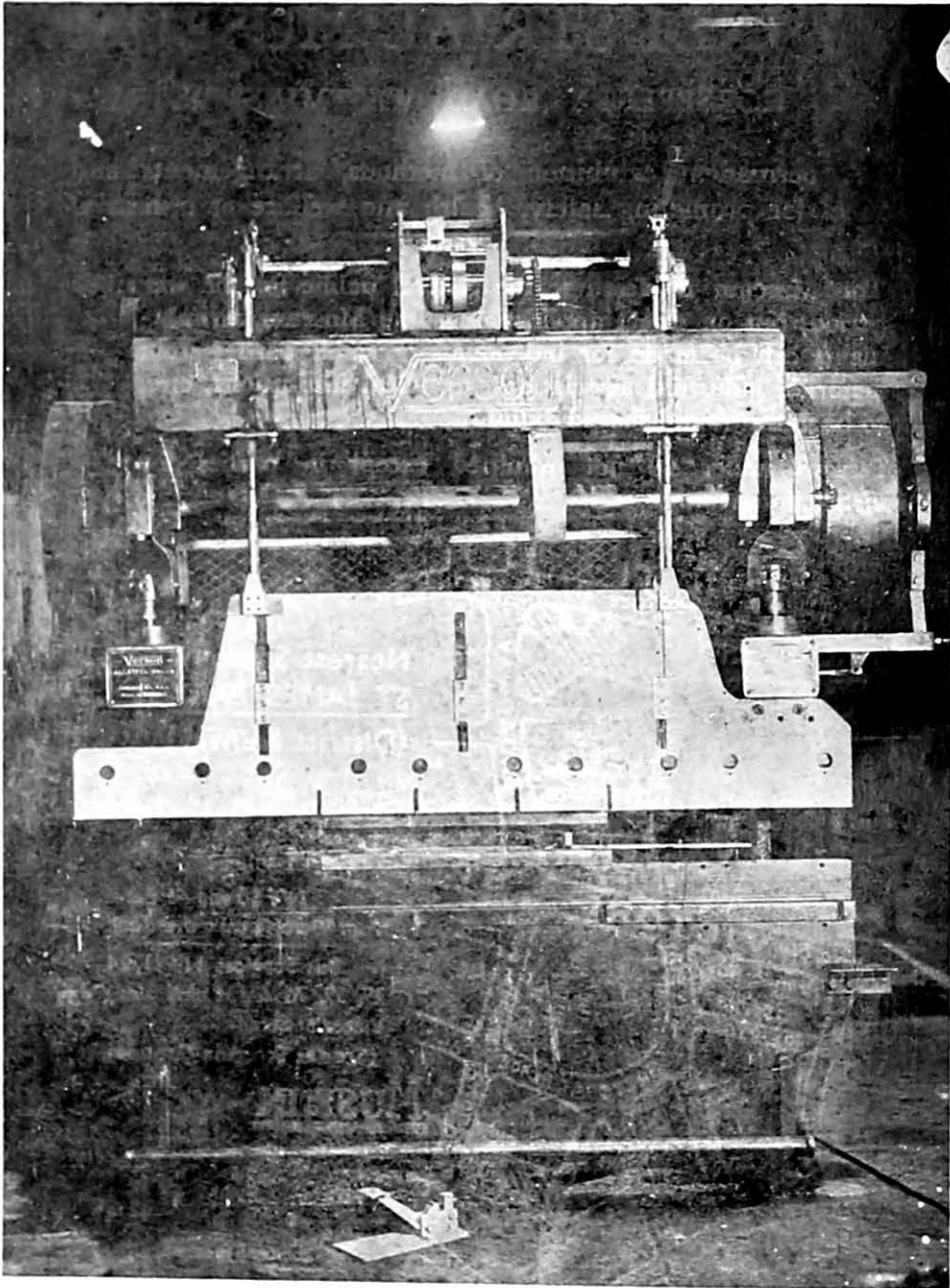


FIGURE 7.

Full front view of bending brake with guard fitted with screen in top position.



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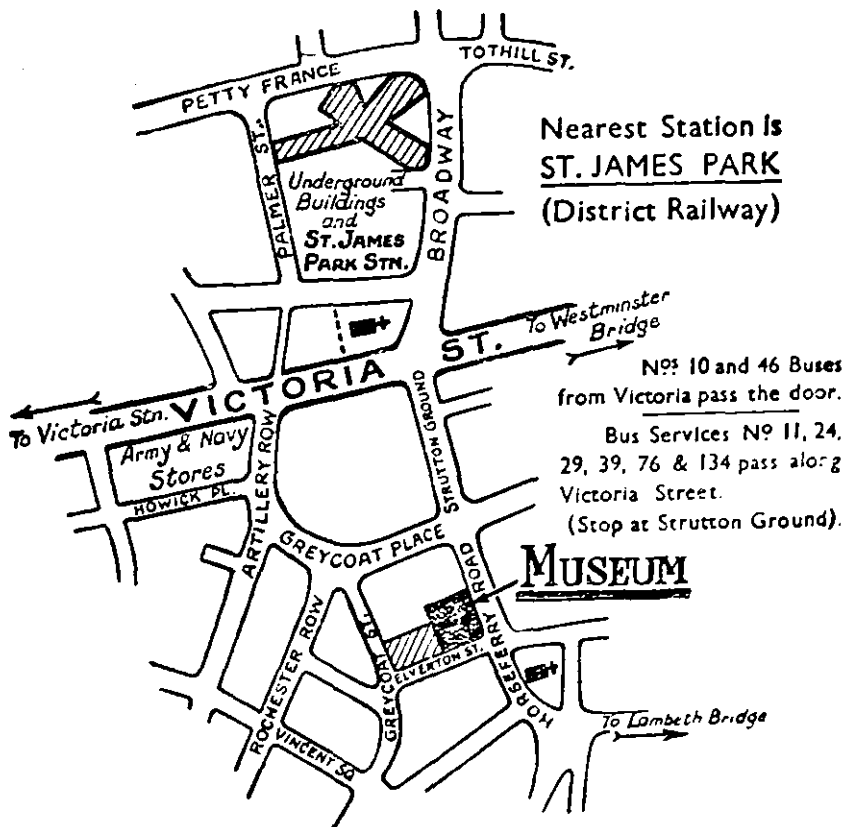
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LONDON

PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

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1945

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