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[54] **INERTIA BALANCING MEANS FOR POWER PRESSES**

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[52] **U.S. Cl.** **74/50**, 83/615, 74/604

[51] **Int. Cl.** **F16h 21/18**

[58] **Field of Search** 74/50, 44, 586, 587, 74/588, 589, 590, 603, 604; 83/615, 628

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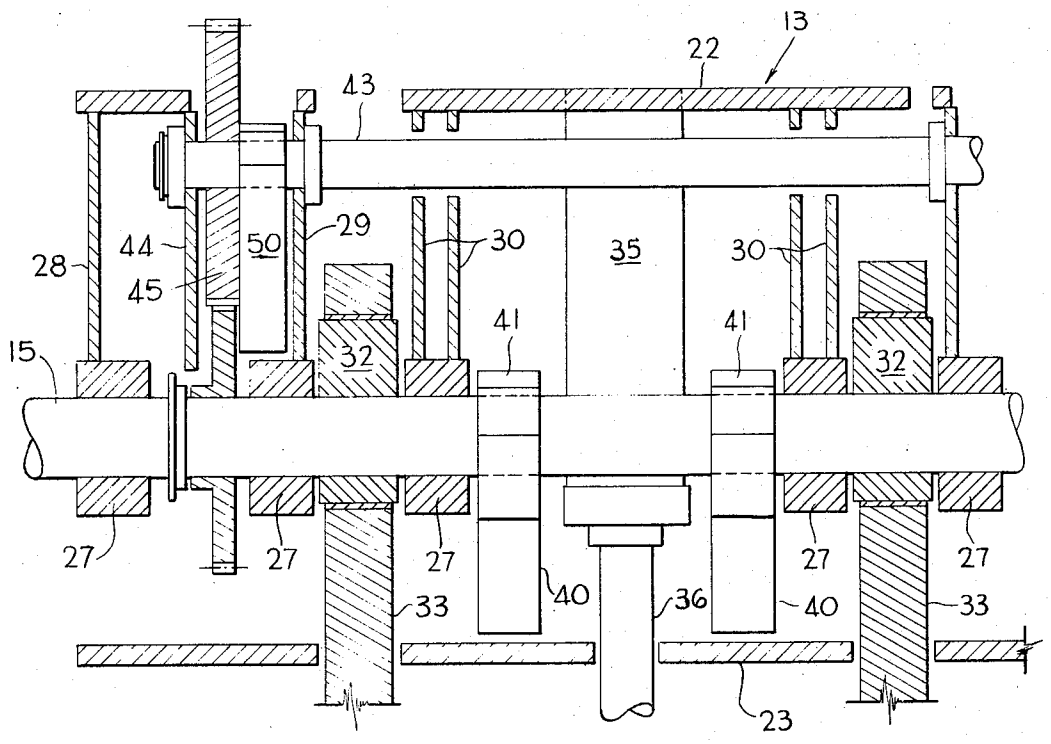
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[57] **ABSTRACT**

In power presses such as are used for stamping sheet metal and the like, the inertia forces of the reciprocating slide of the press and its attached parts set up very heavy and objectionable vibrations, particularly in high speed presses. The present invention provides primary and secondary counterweights. The primary counterweights rotate with the crankshaft or eccentric shaft of the press but with the center of gravity of the counterweight moving in a direction opposite to the direction of movement of the slide to neutralize at least a portion of the inertia forces of the slide and its connected parts. The secondary counterweight rotates opposite to the first counterweight but with its center of gravity moving in the same direction with respect to the vertical, so that the second counterweight has a cumulative effect with respect to the primary counterweight in neutralizing vertical inertia forces but has a subtractive effect with respect to lateral inertia forces produced by rotation of the primary counterweight.

4 Claims, 3 Drawing Figures



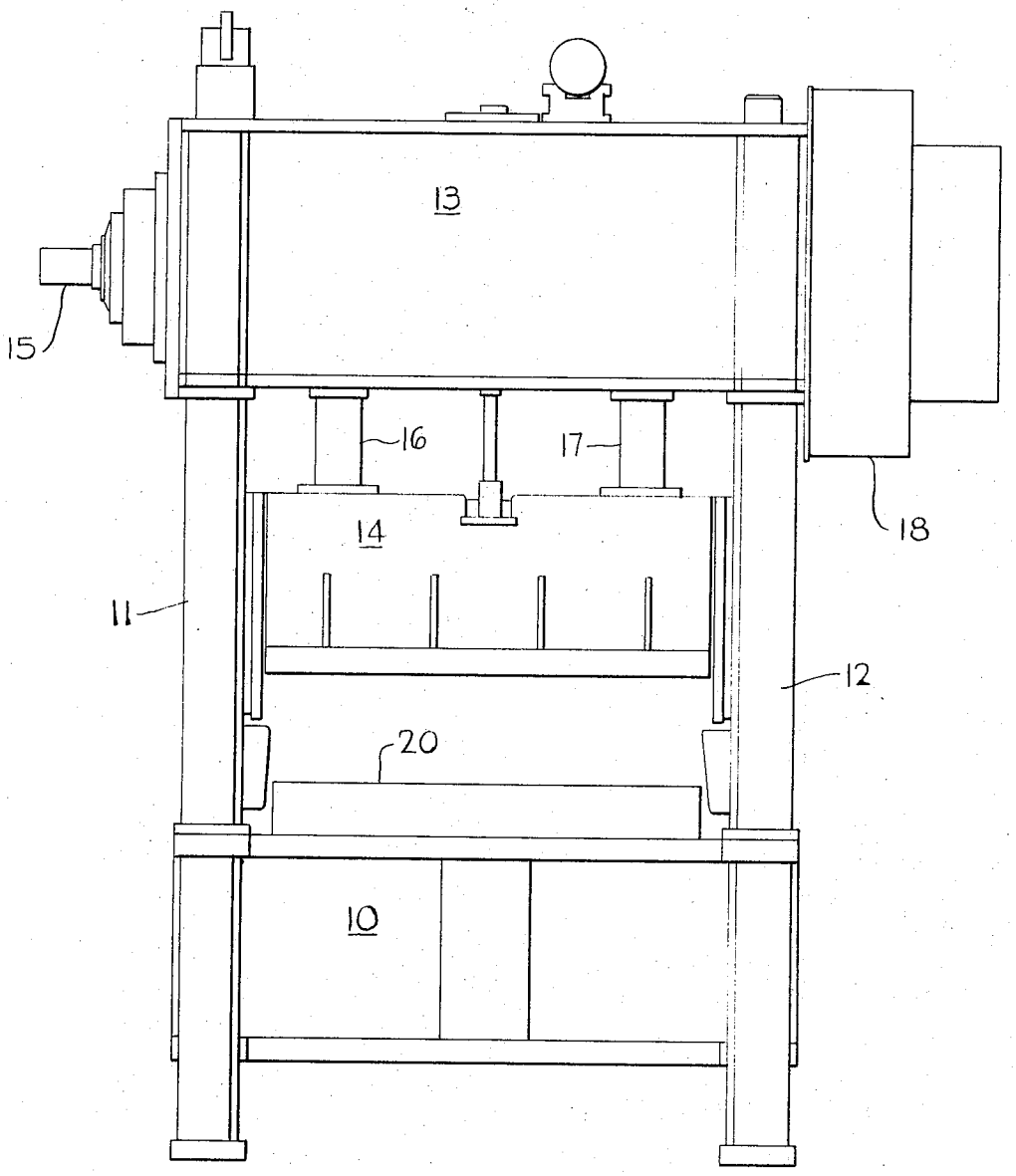


FIG. 1.

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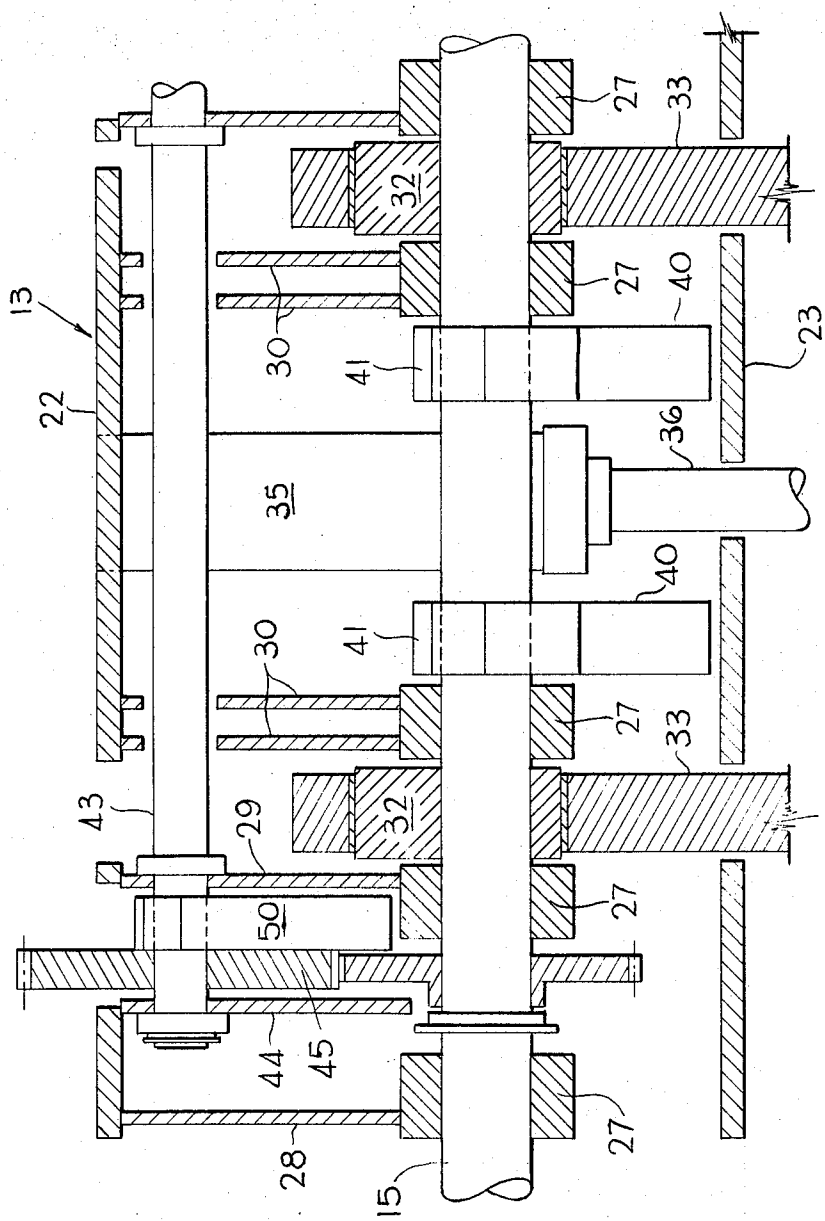


FIG. 2.

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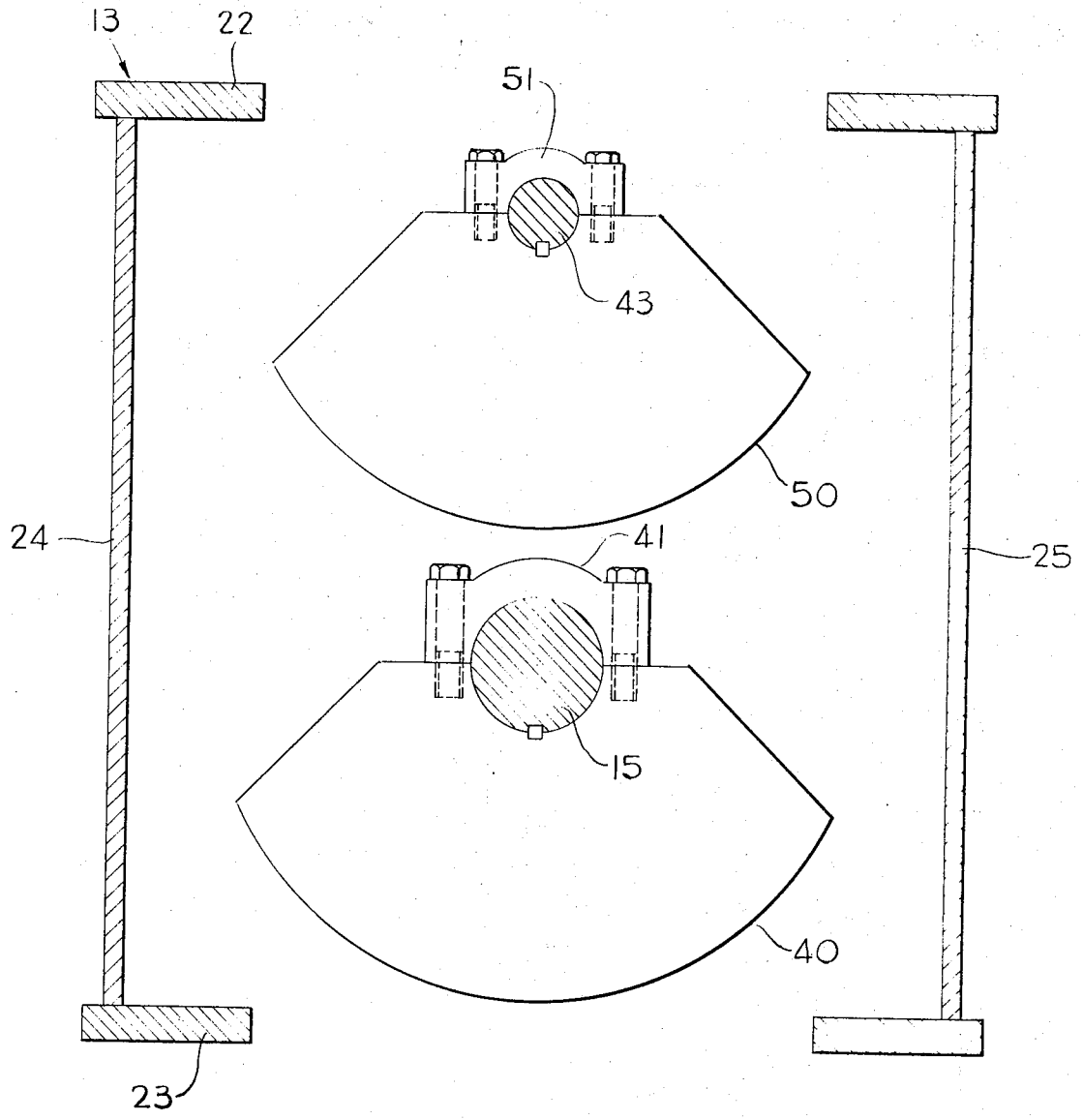


FIG. 3.

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INERTIA BALANCING MEANS FOR POWER PRESSES

BACKGROUND OF THE INVENTION

This invention relates to power presses and, particularly, to means for substantially reducing the inertia forces developed therein.

In conventional power presses one of the cooperating die members is secured to the bed of the press and the upper die member is secured to the usual reciprocating slide or ram of the press. Thus the weight of the slide itself, the movable die attached thereto, the connection between the slide and the crankshaft or eccentric shaft which reciprocates the same, and the eccentric portion of the shaft, all make up a reciprocating mass of very substantial magnitude. In present day high speed presses the heavy vibrations generated by this rapid reciprocation and the shaking forces developed in the machine and transmitted to the building structure present very severe problems.

Such means as have been proposed in the prior art for ameliorating these conditions have only slightly improved the situation and the requirement for ever-increasing operating speeds of power presses renders a better solution to the questions of vibration as of prime importance in power press design.

SUMMARY OF THE INVENTION

The present invention provides means whereby a very large percentage of the inertia forces developed by the reciprocating mass of the press is neutralized in a very effective and practical manner.

Counterweight means fixed to the crankshaft or eccentric shaft of the press having a center of gravity offset from the axis of the shaft and oriented so that the eccentric mass of the counterweight is in a lower dead center position when the slide is in an up position, and vice versa, will tend to balance out a portion of the inertia effect of the reciprocating slide and its connected reciprocating parts, but this solution presents a collateral problem since the rotating eccentric mass of this counterweight means introduces lateral inertia forces which increase rapidly with increased mass of the eccentric counterweight and thus greatly limit the use of this expedient and militate against its effectiveness.

In the present invention, in its broadest aspect, the use of such a counterweight means is rendered feasible to much more fully neutralize the inertia effect of the reciprocating slide and its connected parts by providing a second counterweight means rotating in a direction opposite to that of the first counterweight means but arranged so that the eccentric masses of both counterweight means are at bottom dead center at the same time and at top dead center at the same time. Thus the eccentric masses of the two oppositely rotating counterweight means act cumulatively in opposition to the inertia forces of the reciprocating mass comprising the power press slide and its connected parts. On the other hand, due to the opposite rotation of the two counterweight means, the second counterweight means introduces lateral inertia forces in opposition to the lateral inertia forces of the first counterweight means to subtract from lateral inertia forces developed by the first counterweight means.

In general, or in most instances, the second oppositely rotating counterweight means will be of less mass, or of less inertia effect, than the first means. This is due

to the fact that a portion of the lateral effect of the first counterweight means is cancelled out by the opposite lateral effect of the drive means for the slide, that is, the rotating or revolving parts of such drive means. A major part of the connection between the crankshaft or eccentric shaft and the slide and the eccentric mass of the driving cranks or eccentrics themselves, all develop lateral reciprocating inertia forces which are opposed to the lateral inertia forces of the first counterweight means, by reason of the fact that the eccentric mass of the first counterweight means is at bottom dead center when the slide and its driving connection is in uppermost position, and vice versa. Since the first eccentric counterweight means and the slide drive means rotate in the same direction, this places their effective masses at an angular spacing of 180° at all times.

For the foregoing reason, the second counter-rotating counterweight means need only be of sufficient mass or inertia to balance out the excess of lateral inertia forces of the first counterweight means, for optimum results.

In most adaptations of the principles of the present invention the foregoing eccentric counterweight means will be in addition to the usual primary flywheel of the machine although the rotational inertia forces of the counterweight means of the present invention may somewhat reduce the requirement for rotational inertia energy in the principal flywheel of the machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a general front elevational view of one type of power press to which the principles of the present invention may be applied;

FIG. 2 is a fragmentary vertical cross sectional view through the crown portion of the power press of FIG. 1 in the plane of the main shaft thereof; and

FIG. 3 is a transverse cross sectional view taken approximately on the line III—III of FIG. 2 with parts omitted for clarity of illustration.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

FIG. 1 shows a conventional straight side power press having a bed **10**, side frames **11** and **12**, a crown **13**, and a vertical reciprocable slide **14** driven from a main shaft **15** by reciprocable connections **16** and **17**. In FIG. 1 the numeral **18** designates a housing which contains a conventional flywheel mounted on main shaft **15** and the usual clutch and brake mechanism (not shown) is interposed between the flywheel and main shaft **15**.

It will be understood that a die set will be employed in the power press of FIG. 1 with the stationary unit thereof secured to a bolster plate **20** on bed **10** and with a movable member of the die set secured to the underside of slide **14**.

Referring now to FIG. 2, crown **13** includes upper and lower walls **22** and **23** and, as shown in FIG. 3, front and rear walls **24** and **25**. In the present instance, main shaft **15** is supported by a series of six bearings **27** which are carried by vertical wall members designated **28, 29** and **30** in FIG. 2, the wall members being welded to top wall **22** and front and rear walls **24** and **25**.

The press shown herein by way of example, has a pair of driving eccentrics **32** on main shaft **15** which are provided with connections **33** to slide **14** for reciprocating the latter vertically. A conventional counterbal-

ancing cylinder which is fixed to upper wall **13** is shown at **35** and has a shaft connection **36** to slide **14.** All of the foregoing is conventional construction in power presses of this general type.

In the machine shown and described herein to illustrate the principles of the present invention, main shaft **15** is provided with a pair of semi-circular counterweights **40** which are fixed to the main shaft by bearing caps **41.** In the position of parts illustrated in FIGS. **2** and **3,** the eccentrics **32** and slide **14** are at top dead center and the semi-circular counterweights **40** are at bottom dead center.

A countershaft **43,** supported in the left-hand vertical wall member **29** and a further similar vertical wall member **44,** is connected to main shaft **15** by gears **45** and **46** of equal pitch diameters so that countershaft **43** rotates synchronously with main shaft **15** but in the opposite direction. A further semi-circular counterweight **50** is fixed to countershaft **43** by means of a bearing cap **51** and is likewise in its bottom dead center position when eccentrics **32** and slide **14** are in their upper positions.

From the foregoing it will be noted that the two counterweights **40** and counterweight **50** will all move upwardly as the slide **14,** the eccentrics **32** and the connections **33** move downwardly, and vice versa. Thus the vertical inertia components of the three counterweights act in opposition to the vertical inertia of slide **14,** eccentrics **32,** connections **33** and the movable die member carried by slide **14.** Furthermore, since counterweight **50** rotates reversely to counterweights **40,** the lateral component of counterweight **50** acts in opposition to the lateral components of counterweights **40.** As indicated earlier herein, the lateral components of counterweights **40** are in part counterbalanced by the lateral components of the eccentrics **32** and the connections **33** and, accordingly, the mass of counterweight **50** will be substantially less than the mass of counterweights **40.**

For ease of description and by way of example, reference has been had herein to a vertical movable slide and to counterweight means movable to properly neutralize the inertia forces of a vertically movable slide. However, it is to be understood that the same principles may be applied to a power press slide which reciprocates in a horizontal direction, or in any other direction. Furthermore, while the counterweight arrangement of the present invention may aim at substantially full counter-balancing of the objectionable inertia forces of the slide of a power press, various conditions and limitations may dictate something less than such full neutralization without departing from the principles of the present invention.

A preferred embodiment has been described herein and shown in the accompanying drawings to illustrate the underlying principles of the invention but it is to be understood that numerous modifications may be made without departing from the broad spirit and scope of the invention.

I claim:

1. In a power press having a frame including a bed, a slide reciprocable with respect to said bed and connectible with a movable die member to effect working strokes thereof, a continuously rotating shaft having eccentric drive means and means connecting the same to said slide for reciprocating the same; first counterweight means rotatable with said drive shaft and having its center of gravity opposite to that of said eccentric drive means whereby said first counter-weight means moves in opposition to the movement of said slide, and second counterweight means synchronized with said first counterweight means to rotate continuously at the same speed but in the opposite direction, the center of gravity of said second counterweight means being offset from its axis of rotation in the same direction as that of the first counterweight means with respect to the direction of the slide, whereby said two counterweight means move in unison with respect to the direction of said slide but oppositely with respect to a direction at right angles thereto.

2. Apparatus according to claim **1** wherein said first counterweight means is mounted on said drive shaft for rotation therewith.

3. Apparatus according to claim **1** including a countershaft and transmission means connecting the same to said drive shaft for rotation at a one to one ratio therewith but in the opposite direction, said second counterweight means being mounted on said countershaft for rotation therewith.

4. Apparatus according to claim **2** including a countershaft and transmission means connecting the same to said drive shaft for rotation at a one to one ratio therewith but in the opposite direction, said second counterweight means being mounted on said countershaft for rotation therewith.

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