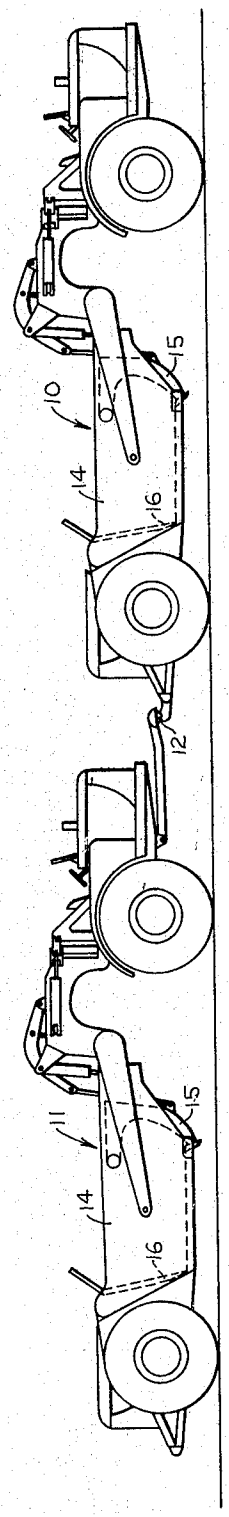
Dec. 13, 1966 R. A. PETERSON 3,290,806

CONTROLS FOR TANDEM OPERATED EARTHMOVING SCRAPERS

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Fig. 1.




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FIG-2

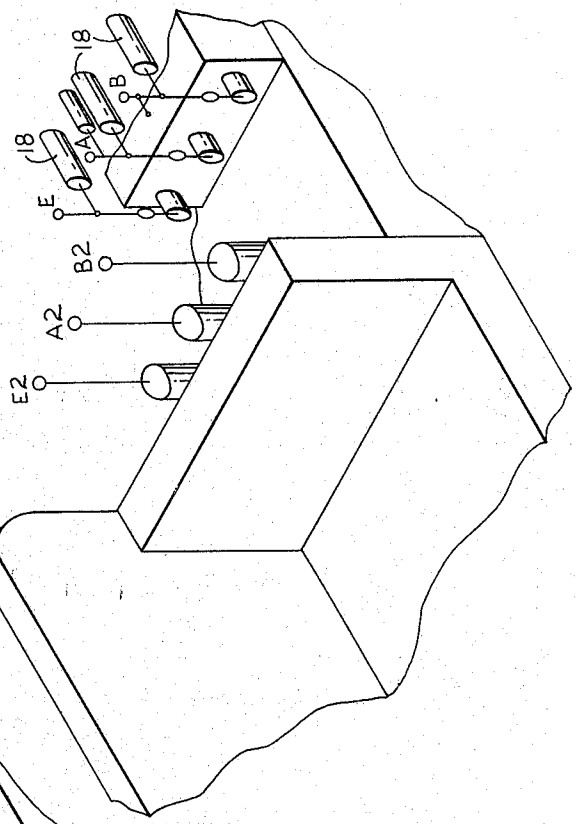
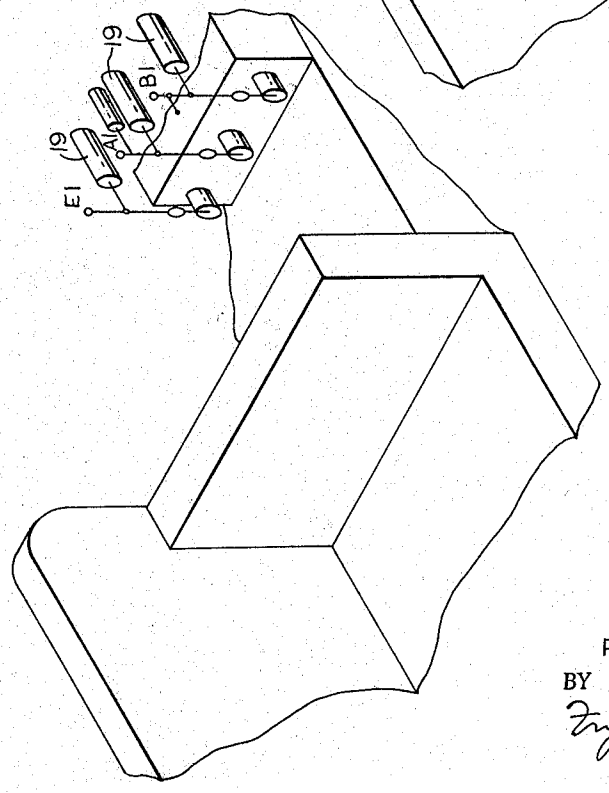



FIG-3




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CONTROLS FOR TANDEM OPERATED EARTHMOVING SCRAPERS

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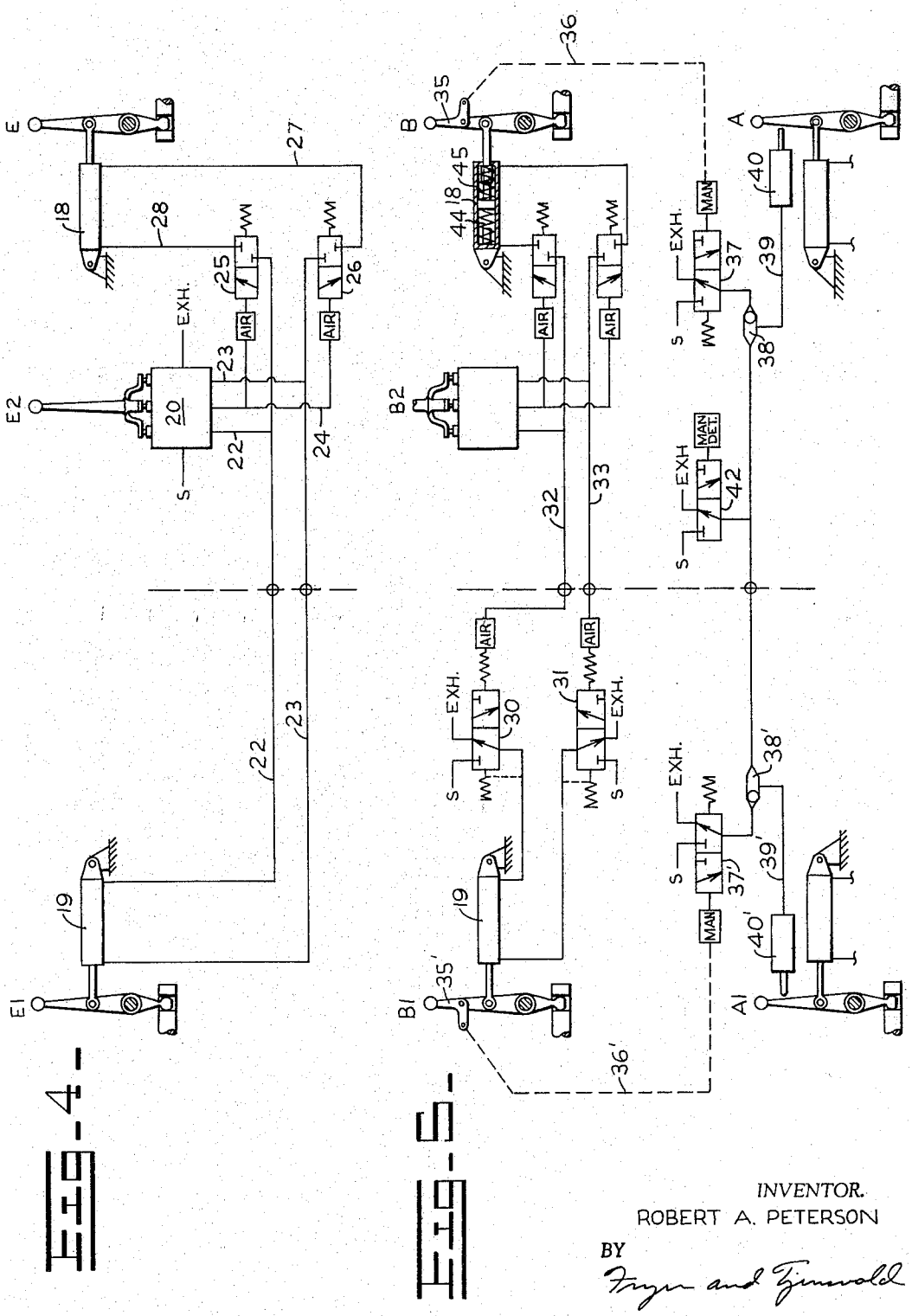



FIG-4-

FIG-5-

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# CONTROLS FOR TANDEM OPERATED EARTHMOVING SCRAPERS

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This invention relates to controls for tandem operated earthmoving scrapers and particularly to controls which enable an operator on one scraper to actuate the adjustable components such as the bowl, apron and ejector of a connected scraper as well as those on the first scraper and to enable such actuation of two scrapers to be accomplished selectively or simultaneously.

The operation of two or more earthmoving scrapers in tandem by a single operator has proven feasible and economical. However satisfactory interconnection of controls presents several problems which are solved by the control system of the present invention. Because of the high cost of large earthmoving machines and because the use of tandem machines is limited to large or special projects, the machines coupled in tandem should be readily available for smaller jobs. This requires that the machines coupled for tandem operation be complete, fully powered and individually controllable units and that interconnecting control mechanisms and circuits do not interfere with ready separation and use of the individual units.

Versatility of control is also desirable because of the demand for speed in the various steps of an earthmoving cycle. For example, as a two-scraper tandem unit enters a borrow pit, it is desirable to lower both bowls to accumulate earth and weight which increases traction and then to raise one bowl so that all motive power of both scrapers is available for the greater task of completely filling a bowl. The filled bowl is then raised and the other bowl lowered to be filled and raised as the unit leaves the borrow pit. Since the length of the borrow pit is often limited and the foregoing and various other operations must be performed, it is important that the operators be able to lower both bowls simultaneously as well as to raise and lower either bowl selectively. Such versatility of control is also necessary for the apron and ejector for most efficient operation under various conditions.

It is, therefore, the object of the present invention to provide controls for tandem scrapers which embody all of the desirable features mentioned above as well as other features which contribute to efficiency of operation, all of which will be made apparent in the following specification wherein reference is made to the accompanying drawings.

In the drawings:

FIG. 1 is a view in elevation of two scrapers coupled in tandem and to which the controls of the present invention are applicable;

FIG. 2 is a fragmentary view of a portion of the operator's station on the forward tractor of FIG. 1 showing control levers for the controls of the present invention;

FIG. 3 is a similar view of a portion of the operator's station on the rear tractor illustrating control levers thereon which when the tractor is coupled in tandem are controlled from the operator's station of the forward tractor;

FIG. 4 is a schematic view of the circuit for the controls of the scraper ejectors; and

FIG. 5 is a schematic view illustrating certain features of the control of the scraper bowls and scraper aprons.

FIG. 1 shows two scrapers coupled in tandem, the forward scraper being generally indicated at **10** and the rear



scraper at **11**. They are coupled by a ball and socket connection shown at **12**. The scrapers are of conventional construction in which a two wheel tractor having an engine for driving its two wheels draws a scraper also having two engine driven wheels. Each scraper comprises three hydraulically actuated elements which are a bowl **14** adapted to be raised and lowered with respect to the ground, an apron **15** adapted to be raised and lowered to open and close the forward end of the bowl and an ejector **16** adapted to be advanced and retracted for ejecting the contents of the bowl. These adjustable components and the hydraulic circuits by means of which they are actuated are all well known and conventional. The present invention relates to the operation of these components from a station on one of the tractor-trailer units and such a station is represented in FIG. 2 while the comparable station on the other, usually the rear unit, is illustrated in FIG. 3. These figures show valve control levers B, A and E for actuating the bowl, apron and ejector, respectively of the forward tractor and in FIG. 3, levers B1, A1 and E1 are shown for operating the bowl, apron and ejector respectively of the second unit. These levers are conventional and operate conventional hydraulic actuating mechanism for the scraper components all as clearly shown for example in the Hein and Junck Patent No. 3,115,716 for "Hydraulic Circuit for Tractor Driven Scrapers and the Like".

The present invention is concerned with the operation of the scraper components on the forward tractor and rearward tractor independently of each other or, alternately, for operating the components of both scrapers simultaneously. This is accomplished by means represented in FIG. 2 as auxiliary levers B2, A2 and E2 which control air valves for directing air under pressure to cylinders **18** arranged to actuate the levers B, A and E and with identical cylinders **19** on the rear scraper for actuating the control levers thereon.

The lever E2 is shown in FIG. 4 as operating an air valve **20**. This valve is operable by rocking of the lever to left or right as shown to direct air from a source under pressure to lines **22** and **23**, respectively, and is also operable by rocking movement in the right angular direction that is forwardly or out on the plane of the paper to open the valve for admitting air under pressure to a line **24**. By rocking the lever in two directions, that is left and forwardly, the lines **22** and **24** will be charged with air under pressure and by rocking this lever toward the right and forwardly the lines **23** and **24** will be charged with air under pressure. A detailed description of the manner in which the valve operates is not pertinent to an understanding of the present invention and such valves are readily available on the market, one being known as a "Flexair" valve No. 23BS–1 manufactured by Westinghouse Air Brake Company.

In accordance with the present invention, rocking of the lever E2 to the left or to the right charges the air cylinder **19** of the ejector lever E1 on the rear tractor to rock the lever in either direction for advancing or retracting the ejector through the usual hydraulic circuit. This effects operation of the ejector only on the rear tractor and operation of the ejector only on the forward tractor would be accomplished by normal actuation of the existing ejector lever E. When it is desired to actuate the ejector on both scrapers simultaneously, the lever E2 is moved forwardly (see FIG. 4) and rocked to left or right for advancing or retracting the ejector E1. Meanwhile the forward movement has charged the line **24** which, through branch lines, actuates valves **25** and **26** to admit air under pressure from either line **22** or **23** to lines **27** or **28** to admit air to one end or the other of cylinder **18** and actuate lever E. Consequently manipulation of lever

E2 in two directions effects simultaneous operation of the ejectors on the forward and rear scrapers.

The controls for actuating the bowl and apron are illustrated in FIG. 5 and, referring first to the bowl controls including levers B, B1 and B2, the actuation of the bowls independently and simultaneously is identical with the actuation of the ejector as described above. However in raising and lowering the bowl a quick action is desired and due to the remote position of the air valve on the forward tractor and the hydraulic valve to be actuated on the rear tractor the long column of air in the connecting conduits produces an air cushion which tends to cause a delayed action. This is avoided by using air under pressure from a source on the rear tractor for actuating the rear bowl control lever and using air from the forward tractor only for the purpose of actuating smaller valves for controlling the actuating air on the rear tractor. Consequently valves **30** and **31** are interposed in lines **32** and **33** which correspond to the lines **22** and **23** of FIG. 4. Thus air directed toward the rear scraper bowl actuating cylinder **19** merely opens one of the valves **30** or **31** admitting air under pressure from a close source to the cylinder **19** for actuating the bowl control lever B1.

The controls for the apron are also shown in FIG. 5 and include apron control levers A and A1, control lever A2 being omitted since its function is identical with levers E2 and B2 previously described, and this portion of the circuit is also identical to the corresponding circuits previously described. Another feature of the conventional hydraulic circuits for actuating the scraper components enables the apron to be lowered simultaneously with raising of the bowl. This is desired because if the apron and bowl are actuated sequentially, a considerable quantity of earth may be spilled from the open end of the bowl as it is being raised and before the apron arrives at its closed position. This has been accomplished by small auxiliary levers **35** and **35'** on the hydraulic bowl control levers B and B1. The lever **35** is mechanically connected as represented by the broken line **36** with an air valve **37**. This air valve may thus be actuated from a normally closed to an open position by manipulation of the lever **35** at the same time that the operator's hand is moving the lever B for raising the bowl. Opening of the valve **37** admits air through a shuttle valve **38** moving its ball to the position opposite to that shown and directing air through a line **39** to an air cylinder **40** which actuates the apron control lever A or A1 to its apron-lower position. Parts **35'** to **40'** perform the same function on the rear scraper. The mechanisms just described are employed individually when the scrapers are not used in tandem. However in tandem use, the lever **35** will be used for lowering the apron simultaneously with raising of the bowl on the forward scraper only. Simultaneous bowl-apron operation of this type for both scrapers is accomplished by a manually actuated valve **42** also disposed at the operator's station for admitting air simultaneously through both of the shuttle valves **38** and **38'** and to both of the actuating cylinders **40** and **40'**.



To insure quick return of the bowl levers B and B1 and the apron levers A and A1 toward their neutral position, after they have been actuated by the air cylinders **18** and **19**, these cylinders are spring centered by springs disposed on opposite sides of the piston as illustrated at **44** and **45** in FIG. 5. These springs augment the force of centering springs employed in the valves controlled by the hydraulic levers. They may be used but are not necessary in the ejector actuators because rapid response is not essential in ejector operation.

With the above described construction, complete versatility of operation of the components of both scrapers has been achieved through relatively simple and easily manipulated mechanisms and the operating mechanism of the individual scrapers have been preserved intact so that a minimum of adjustment or rearrangement is necessary to re-establish the scrapers used in tandem as completely independently operable units.

What is claimed is:

**1.** In combination with two earthmoving scrapers connected for tandem operation in which each scraper has an operator's station with independent controls for actuating adjustable scraper components independently of the other scraper, auxiliary controls at the operator's station of a first scraper for tandem operation, means connecting the auxiliary controls to the independent controls of a second scraper for actuation thereby, means connecting the auxiliary controls to the independent controls of the first scraper for actuation thereby, and means enabling selective operation of the auxiliary controls to adjust scraper components on the second scraper only or to adjust scraper components on both scrapers simultaneously.

**2.** The combination of claim **1** in which the adjustable scraper components are hydraulically actuated and the independent controls are hydraulic valves, and the auxiliary controls are air valves in a pneumatic system for actuating the hydraulic valves.

**3.** The combination of claim **2** in which each scraper has a source of air under pressure, and in which at least one independent control valve on the second scraper is actuated by its own air which is in turn controlled by air from the first scraper.

**4.** The combination of claim **1** in which the adjustable components of each scraper is a bowl, an apron, and an ejector.

**5.** The combination of claim **4** in which each scraper has a control for raising the bowl and simultaneously lowering the apron, and means at the station having auxiliary controls to cause such simultaneous operation on both scrapers.

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